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MAN'S RELIGION THE EXPRESSION OF HIS KNOWLEDGE.

SOME time since a series of papers appeared in KNOWLEDGE under the title "The Unknowable," in which we attempted to show how that borderland beyond the known (or what is supposed to be known) in which lie all the vague possibilities man is ever ready to picture where ignorance or imperfect knowledge permits, is the true domain of religious aspirations in so far as they belong to emotional faith. We now propose to supplement those papers by a series showing in what sense religion is the outcome of knowledge, and how the religion of every nation and of every age has ever been the expression of the knowledge (such as it has been) of each nation and each age. We shall, in fact, strive to do for religion from one special point of view what Professor Drummond has striven to do for it from another. He has endeavoured to show that in the spiritual world there are natural laws akin to those which the student of science has learned to recognise in the world of matter. We shall endeavour to show that the men of every age and nation have striven to embody in their religion such natural laws as they knew or supposed they knew. In other words, we shall strive to show the eminently reasonable character of all religious systems, nay, of each specific religious dogma—granted only that men had rightly apprehended the significance of the facts of nature as seen by them and as they understood them. We may thus learn how it has come to pass that certain doctrines have been almost universally accepted; others limited to special races or to special times. We shall learn to distinguish what is probably well founded from what is probably unsound in the religions of the human race—not by considering religious doctrines in themselves, but by striving to understand on what ideas about natural facts or natural laws they were originally based. And in this way the true bearing of science on religion will be recognised. For few scientific teachings have any direct bearing on religious doctrines as actually developed, even when they may have the most decided and decisive bearing on the ideas out of which the development of that doctrine sprang. As the discoveries of astronomy have no direct bearing on the doctrines of astrology, while fully interpreting most of the facts on which those doctrines were originally based, so is it with the teachings of modern science in relation to nearly all the doctrines of every religion the world has known. Science can seldom prove or disprove any dogma of religion, but science can in a number of instances say confidently that this or that fact on which such and such dogmas were primarily based must be interpreted thus or thus—as it was interpreted by those who first found in it the germ of some special religious teaching, or (it may be) *quite otherwise.*

In such an inquiry science is working, without doubt, within its proper field. For it is the special aim and purpose of science to interpret facts if it can, and to classify them (for future interpretation, perhaps) where it cannot. The student of religion will also here be engaged on an inquiry which really bears upon religion: for he cannot but be interested in considering the origin of specific religious doctrines; and where observed facts or supposed facts and natural laws more or less clearly discerned have led (as they always have led, first or last) to religious views, it cannot but interest him to inquire how far the observations were real or illusory, and in what degree laws really hold which men have supposed they had determined. The inquiry will extend to each one of those dogmas of religion to which Professor Drummond has striven to extend the idea of natural law, but other matters (outside his subject) will be considered also in our discussion of religious views as the expression of men's knowledge, real or supposed, of nature and her workings.

THE RELIGION OF THE ANCIENT BRITONS.*

II.

IT is among the non-Aryan, pre-Celtic dwellers in Britain that Druidism flourished, and became in large measure mingled with Celtic polytheism, so that the elements of each are not easy of separation. Cæsar says of it that it "is thought to have been invented in Britain, and to have been carried over to Gaul; and at the present time those who wish to gain a more precise knowledge of the system travel to that country for the purpose of studying it."† The straightforward and interesting account which he gives of Gallic Druidism, of the functions of the priesthood and character of the ceremonies, is therefore to be applied, with local modifications, to Britain. But we must guard against giving high-sounding names and titles, and crediting philosophic qualities, to a religion so barbaric in its origin and essence as that of the earlier races of these islands, judging from analogy and from the description of Tacitus and other writers, must have been. A good deal of speculation has been expended on the derivation of the name Druid, the Irish word for which is *draoi*, meaning a magician or soothsayer; but Professor Rhys, after weighing the matter, and citing evidence concerning tree-worship, inclines to the old etymology *drus*, "oak," as the true one. Not only was that tree, as the emblem of Jupiter, sacred among the Romans, who also called the acorns "juglans," *i.e.* "Jovis glans," the fruit of the god; among the Greeks, in whose literature and legends there is frequent reference to the oak as sacred to Zeus, who, as the source of divination, spake through the rustling leaves of the sacred oaks at Dodona; among the Scandinavians, as the tree of Thor; and among the Teutons, as shown in the many vestiges of holy oaks; but also among the non-Aryan Finns, as sacred to Jumala, their supreme god.

Stripped of the philosophic garb in which contact with more civilised races, or with which the imagination of classic writers endowed them, and as yet unmodified by the milder influence of Aryan polytheism, the Druids were doubtless the magicians, soothsayers, and priests—"the swarm of prophesying quacks" as Pliny calls them, corre-

* "Lectures on the Origin and Growth of Religion, as illustrated by Celtic Heathendom." By John Rhys, Professor of Celtic in the University of Oxford. (Williams & Norgate: 1888.)

† "De Bell. Gall." vi. c. 12.

sponding in their assumptions and pretensions to the medicine-men of all barbarous peoples. Shamans, conjurors, sorcerers, wizards, spiritual ancestors of all those who claim to hold the keys of the kingdom of heaven, to bring down gifts for men, to bind or to loose, to absolve or to curse, such men naturally rose to power among, and to rule over, their fellows, whose terrified and undisciplined imagination saw in them the ministers and agents of the gods. "They tamed the people as wild beasts are tamed," and among the convenient weapons which they used in common with wizards the world over, were fetichism, magic, and divination in many forms, notably by the entrails of sacrificed victims and the flight of birds. The old account of their ceremonies in groves, of their cutting with golden sickle the mistletoe when, growing from the sacred oak, it denoted the presence of the god, and of their bearing it on waggons drawn by two snow-white bulls, point to a form of nature-worship which had been assimilated and refined by Celtic polytheism. But we know Druidism only as thus amalgamated, and we need to resolve it into more primitive and grosser elements. One of these is, without doubt, that ghastly rite of human sacrifice which does not, as has been suggested, indicate Semitic influences, but which has its origin in the primitive object and intent of offering to the gods that which, being most valued by man, must be most acceptable to them. If any person of importance were in peril from disease or from the chance of war, a criminal or slave was killed, or promised as a substitute. The Druids held that by no other means could a man's life be redeemed or the wrath of the gods appeased; and they went so far as to teach that the crops would be fertile in proportion to the richness of the harvest of death. It became a national institution to offer a ghastly hecatomb at particular seasons of the year. In some places the victims were crucified, or shot to death with arrows; elsewhere they would be stuffed into huge figures of wickerwork, or a heap of hay would be laid out in the human shape, where men, cattle, and wild beasts were burned in a general holocaust. The memory of the public sacrifices seems to have been preserved by the Irish proverb, in which a person in great danger was said to be "between two Beltain fires." In the Highlands, even in modern times, there were May-day bonfires at which the spirits were implored to make the year productive, a feast was set out upon the grass, and lots were drawn for the semblance of a human sacrifice, and whoever drew the "black piece" of a cake dressed on the fire, was made to leap three times through the flame. In many parts of France the sheriffs or the mayor of a town burned baskets filled with wolves, foxes, and cats in the bonfires at the Feast of St. John; and it is said that the Basques burn vipers in wicker panniers at midsummer, and that Breton villagers will sacrifice a snake when they burn the sacred boat to the goddess who has assumed the title of St. Anne.

The Welsh and Irish traditions contain many other traces of the custom of human sacrifice. Some of the penalties of the ancient laws seem to have originated in an age when the criminal was offered to the gods. The thief and the seducer of women were burned on a pile of logs or cast into a fiery furnace; the maiden who forgot her duty was burned, or drowned, or sent adrift to sea. The lives of the saints and the household fairy tales are full of the miracles by which the innocent queen or princess is saved from an unjust doom.

All these are of the past, yet now and again reminders come to us what strange beliefs are yet nurtured among us, what fetichistic customs still linger, what unlaid ghosts still haunt the barrows, what fairy-darts and elf-bolts are still thrown, what merry dances the little people still have in their fairy rings, what helpful or spiteful things they do, in districts where the thud of the navvy's pickaxe has not disturbed their trysting time, nor the screech of the railway whistle driven them to their underground homes, where, according to Danish legend, their ancestors, the unwashed children of Eve, were cast by Jesus.

The older and grosser elements, never eliminated from Christianity, easily coalesced with those in the pagan religions, which it nowhere thoroughly supplanted. It had attained a richer spiritual development than they, but its roots lie in the same soil, fed by the same needs. The penalties pronounced in its authoritative writings against witches; the vast organised doctrine of demonology which was, and is, an integral part of the teaching of its founder, and therefore of his disciples; the superstitions attached and attaching to the water of baptism, and which led the ignorant rustic to steal it from the fonts for use in magical rites (accounting for locked covers on fonts); these and other elements, of the earth earthy, it shared with other religions, and if it bestowed upon them new names, the essence remained unchanged.

The dressing of wells at Tissington and other places; the wells in the northern counties into which the country girls throw pence as offerings to the spirits; the rags and other votive offerings on trees and hedges around sacred wells in Britain and Ireland; the pilgrimages to St. Gowen's well in Pembrokeshire; are among the undoubted relics of that water-worship which is one of the many departments of the nature-worship of our forefathers, and which is linked with the offerings round sacred wells in India and Ceylon, and with the more graceful Fontinalia of the Romans, when the fountains and wells were garlanded in honour of their nymphs.

One might think that there remained no relic of sacrificial customs which, as we have seen, were so hideous a feature of the old British religion, as of all others at a correspondingly low level; and yet it is recorded that not twenty-five years ago, when a herd of cattle was attacked with murrain, one of them was buried alive as a propitiatory offering for the rest, and that a live ox was burned in Northumberland with the same intent; whilst a remedy for erysipelas applied within recent years was to cut off part of a cat's ear and let the blood drop on the part affected. So in the Highlands and Cornwall, a black cock is buried alive on the spot where a person is first attacked by epilepsy.

Scratch a Russian, says the adage, and you will find a Tatar; scratch a peasant, and, for the matter of that, a good many of his betters, and you'll find a fetichist—a pagan to the core. What will the old crones tell us to this day? That the sickly child will not thrive till it is christened; that the souls of the unbaptised babes wander in the air till Doomsday, or join the mystic team of the Wild Huntsman, be he Arthur or Odin; that the first parings of the infant's nails, which must never be cut on a Friday, should be buried under an ash-tree, in which superstition we see mixed the savage notion of burying nail-parings and other refuse lest the sorcerer work harm thereby, and the important part assigned to the ash in Norse, American, Greek, and other myths; that the mourner on whom the sun shines at a funeral is sure to die; that when birds tap against the window, or ravens croak, or the dogs howl before the house, or the click of the death-watch spider is heard, or, queerest of all, when one's own wraith is met, or a corpse doesn't stiffen, 'tis an omen of death.

Furthermore, that the faithless lover's heart may be tortured by sticking pins into a hare's heart; that 'tis unlucky to look at the new moon through glass; that 'tis wicked to point at the stars or count them—itself a relic of the Aryan ancestor-worship, and of the personifying of the "Fathers" who live in the sky along with Yama, and who are the great original

Pitri of mankind; that one should always invoke a blessing on a sneeze, itself a relic of the well-nigh universal barbaric belief that the sneeze indicates the expulsion of a demon, whose return the invocation prevents; that whooping-cough can be cured by passing the sufferer under a donkey's belly, or by popping a trout's head in its mouth, or putting a hair of the patient's head between two slices of bread-and-butter and giving it to a dog; that toothache can be cured by a charm written in a Bible, as in Africa the sick native drinks the water in which a board with written characters on it has been washed; that rheumatism can be cured by confirmation, or cramp prevented by placing one's shoes toe to heel; that the hair of a dog will cure a dog's bite, a very widespread superstition, from China to Iceland, for the Edda commends it; that the pining away of a child is due to the evil eye; that the idiot child is a fairy's changeling, of the existence of which Dr. Martin Luther was as firmly convinced as was John Wesley of the existence of witches. "Eight years ago," said the famous doctor, "there was a changeling in Dessau, which I, Dr. Martin Luther, have both seen and touched . . . and which I would have had thrown into the water at the risk of being a homicide. But the Elector of Saxony wouldn't follow my advice. I then said they ought to cause a paternoster to be said in the church, that God would take the devil away from them. This was done daily, and the said changeling died two years after."

Such superstitions as are illustrated by the foregoing examples, which could be multiplied indefinitely, are explicable only on the ground that they are survivals of a barbaric past, which have remained persistent throughout the lower culture in these islands from prehistoric times. They have, with differences of detail incident to local characteristics, their parallels in all barbaric thought, and are the product of an age when the races dwelling in Europe were in the animistic stage of belief. That these superstitions remain among us despite the good Providence which has left no parish without a parson and a squire, only shows how the apathy and impotence of these time-honoured institutions have been conserving forces to which the Church, in incorporating into itself what it found too deeply-seated to destroy, and with which it had, without knowing it, much in common, has added her influence and sanction. The main conclusion to which the evidence leads is that the history of races and of their religions in Britain is continuous from the earliest Neolithic times to this day; that the non-Aryan—Iberian, Euskarian, or by whatever name we call them—are not extinct; and that the great body of superstitious beliefs and customs extant witness to stages of spiritual development among the peoples of these islands corresponding exactly to those of every other people who have emerged from fetichisms to those higher animistic conceptions which yet form the backbone of current theologies from "China to Peru."

In our desire to give prominence to the facts which warrant that conclusion, we have left ourselves no space to enlarge upon the copious and valuable analyses of the Welsh and Irish heroic legends, in which Professor Rhys discovers traces of Celtic deities, both major and minor, and of Celtic mythology. The process of transmutation, sometimes involving the degradation which the gods of an older faith undergo, has ample illustration here, and it is in the identification of the ancient divinities with the kings and heroes of romantic legends common to both Wales and Ireland that the ingenious and cautious scholarship of Professor Rhys is especially manifest.

While not committing himself to that wholesale rejection of the philological method of interpreting myths, Professor Rhys honestly admits that his views and methods have undergone material change, and he further wins our confidence by his recantation of that "Aryan heresy" of which Professor Max Müller seems likely soon to find himself the sole defender, and by his frank acceptance of the method which compares savage myths and rites with the traces of like absurdities and practices imbedded in the literatures and theologies of civilised races. In the concluding lecture, after justifying the dethronement of Sanskrit from its over-exaggerated place as the special representative of the Aryan parent-speech, and expressing his agreement with the revived theory of the Northern European origin of the Aryans,* he concludes his learned book with the following summary of what he regards as the earliest creed of the Celts:—

In the beginning Earth and Heaven were great world-giants, and they were the parents of a numerous offspring; but the Heaven in those days lay upon the Earth, and their children, crowded between them, were unhappy and without light, as was also their mother. So she and they took counsel together against Heaven, and one of his sons, who was bolder than the others, undertook shamefully to mutilate Heaven—nay, he and his brothers stayed not their hands till they had cut the world-giant, their father, into many pieces.† Out of his skull they made the firmament, and the spilling of the blood of his body caused a great flood, which, as it settled in the hollows of the earth, made up the sea.‡

Some of the children of Earth and Heaven were born bright beings or gods, who mostly loved the light and the upper air; and some were giants or Titans, who were of a darker and gloomier hue. These latter hated the gods, and the gods hated them. The daring son of earth who began the mutilation of the world-giant was one of the Titans, and he became their king; but the gods did not wish him to rule over them and their abode, so he was driven from his throne by his youngest son, who was born a god. The king, beaten in battle, sailed away to other parts of his realm; and after much wandering on the sea, he was at last received in the country of the happy departed, whence he was afterwards thought to bless the farmer's toil and to help man in other ways.

When the great flood caused by the mangling of the world-giant took place, all men were drowned save a single pair saved in a ship. He who made and owned the ship was not a man, nor did the gods own him as one of them, but he was a giant or Titan who was kindly disposed towards the race; and when he had safely landed them where they were to dwell, he went away to the same place as the dethroned king. For he was of his kith and kin, unless perhaps those are to be followed who thought the two were but one and the same person, and that person no other than the ruler of the departed himself, the god of all beginning and all end. Viewed through the medium of the latter, he appeared to be the demon of darkness and horror and death, ever busily adding to the number of his victims; but through the former he was seen to be the first father and great parent of all, so it was ever a matter of piety to reckon darkness before light, the night before the day, and winter before summer.

The new king of the gods was of a passing brilliant nature, so they called him Bright and Day and Father Sky. He was a mighty warrior, but he had terrible foes, who forced him to take part in many a fearful struggle. When he fought in summer he always triumphed, but he fared ill in the winter conflicts. On one occasion he was badly wounded, and would never have recovered his former strength and form but for the timely aid of a man who was a cunning leech, and on another he and the other gods would have been hard beset had they not taken care to secure the help of the Sun-hero. This last was not a god, but the youthful son of a mortal. There was, however, no spearman anywhere to equal him, and his father was so wise and crafty that he had forced the gods to treat mankind far better than they had before been wont to do. For the good things bestowed on man were often begrudged by the gods, and most of all by the owners of the wealth of the nether world and the land of the happy dead. They hated this mortal, so kind to his race, and made him suffer untold pain and torture, but he always succeeded in the end in all that he set his mind on achieving, as when, for example, he cheated them of the dog that was to be the hunter's friend and servant; also of the other animals he stole from

* Cf. Professor Rhys's excellent discussion of this question in his article on "Race Theories and European Politics" in the *New Princeton Review*, January 1888.

† Vid. KNOWLEDGE, April 1888, p. 136.

‡ Cf. Grimm, "T. Mythol.," 559; and Vigfusson and Powell's "Corpus Poet. Boreale," i. 64.

them as likely to be of use to his kindred. It was from the same nether country that he likewise obtained by craft and falsehood the strong drink that was to cheer man, to give him the dreams of poets and the visions of prophets. These and other boons, too many to name one by one, made him very famous and beloved, more so in some lands than even the king of the gods himself.

ENGLISH PRONUNCIATION.

AT first sight it seems strange that the pronunciation of English, though diverse both in America and in England, is more diverse in the old home of the language than in the new. But so soon as we recognise why this is, and why even in Scotland and Ireland peculiarities of pronunciation are retained which have long since been lost in England, we perceive that in past ages English in England must have been even more diverse than it is now, and must have tended to change more rapidly. The circumstances which, while encouraging the growth of a language, tend to uniformity of usage—as constant and ready intercommunication, widely read literature, and the like—were almost wholly wanting when our language was young; nor was the necessity apparent in any of the earlier English communities for such care in teaching as might prevent unduly rapid changes.

Those who remember England as it was but a generation ago will see that there has been even in that time a marked advance towards uniformity. The English of Northumberland was distinct from that of Yorkshire, and neither was like the English of Cumberland or Lancashire. The midland counties had various dialects; while the dialects of Dorsetshire, of Wiltshire, or of Devon were not only different from any used in the midland or northern counties, but differed widely *inter se*. In places remote from considerable towns the language spoken was almost as difficult to understand as Dutch or Frisian.

That in long past times "English as she was spoke" in different places was various and variable is shown also by the language as it was written. Bishop Edfrid, about the year 700, began the Lord's Prayer thus:

Uren fader thic arth in heofnas, sic gehalgud thin noma; so cymeth thin ric; sic thin will a sue in heofnas and in eorths.

Only two centuries later the same part of the prayer was thus rendered:

Thue ur fader the eart on heofenum; si thin nama gehalgod cume; thin rice ["c" hard]; *si thin willa on earthan swa swo on heofenum.*

We may be sure it was not difference in time only, but difference in dialect which caused this difference of form. Indeed some of the words in the more recent rendering are older in form than those in the earlier.

About the year 1160, Adrian, our only English Pope, rendered the same part of the Lord's Prayer in the following poetic form, probably the earliest rhymed poetry in the language:—

Ure fader in heaven rich * (rich = kingdom),
Thy name be halyed everlich,
Thou bring us thy michell blisse;
Als hit in heaven y doe,
Evar in yearth been it alsoe.

(Observe the looseness of his Holiness's aspirates, as shown in "hit" and "it.")

In 1537 the Lord's Prayer, as printed for general use, began thus:—

O oure Father which arte in heven, hallowed be thy name: let thy kingdom come, thy will be fulfilled as well in erth as it is in heven, etc.

* "Ch" hard and guttural throughout.

We see here most striking evidence of the influence of printing in preventing the rapid change of a language, and in smoothing down diversities already existing. For while the earlier forms of the same sentences might have been in different languages, so diverse are they, we find in 1537 a form which differs only in spelling from the language of to-day. (I doubt whether the "e" in "oure" and "arte" was sounded in the sixteenth century, though it certainly had been in the fourteenth. Probably it was a mere survival in spelling, like the final "e" in "were," "are," &c.

But on this question of diversity of dialect in the past as at the present time in England, we have curious evidence in an address, written A.D. 1385, on this very subject:—

As it is knowe how meny maner peple beeth in this lond, ther beeth also so many dyvers longages and tonges. Natheless Walschemen and Scots that beeth nought medled with other nation, holdeth wel nyh hir firste longage and speche; but yif the Scottes, that were sometime confederate and woned with the Pictes, drawe somewhat after hir speche; but the Flemynges, that woneth on the west side of Wales, haveth lost her strange spech, and speketh Sexonliche now. Also Englishemen, they had from the begynnynge thre maner speche; northerne, southerne, and middel speche in the middel of the lond, as they come of thre maner of peple of Germania; notheless by commystion and mellynge, first with Danes and afterwards with Normans, in meny the contry longage is apayred (*corrupted*).

This ancient writer, whose very name has been forgotten (I have quoted from Dr. Hicks, of the last century, *verbatim et literatim*, except that he has "contrary" where I have written "contry"), proceeds then to inquire into the cause of this diversity. Strangely enough, he dwells on a point which I shall presently have occasion to consider—the circumstance that a foreign language changes little within a country where it is foreign, while the native tongue varies greatly:—

Hit seemeth a greet wonder how Englischemen and her own longage and tonge is so dyverse of sown in this oon iland, and the longage of Normandie is comlynge of another lond, and hath oon maner of soun amonge alle men that speketh hit aright in Engelond. Also of the aforesaid Saxon tonge that is deled (*divided*) a three, and is abide scarceliche with few uplondissche men, is greet wonder. For men of the est, with men of the west, is, as it were, under the same partie of hevene accordeth more (our author's grammar seems slightly mixed here, at any rate his meaning is not clear) in sownynge of speche than men of the north with men of the south. Therefore it is that Mercii, that beeth men of myddel Englelond, as it were, parteners of the endes, understandeth bettre the side londes, northerne and southerne, than northerne and southerne understondeth either other.

He adds some special remarks about the "maneres of speche" in different parts of the island which might be worth quoting in full if he had used "longage" we could understand. But probably the following specimen will suffice:—

All the longage of the Northumbers, and spechialliche at York, is so scharp, flitting,* and frotynge, and unschape, that we southerne men may that longage unnethe understonde

any more perhaps than we nineteenth-century men can "understonde" what sort of a "longage" our author would indicate by such "very bitter words" as "frotynge" and "unschape," or even by the more familiar "scharp" and "flitting."

Although this evidence as to the constant changes which our language has undergone, and as to the diversity of form and sound which it has presented in the past, even more markedly than at the present time, may prevent us from expecting to discover what was the English spoken in

* In my copy the word reads "slitting." It seems clear, however, that the original word was "flitting."

the time of Shakespeare or at more remote dates, yet we may still hope to recognise some at any rate among the peculiarities which distinguished the English of past times from the English of to-day. The circumstance noted by the old writer above quoted, that foreign languages retain their form—as Norman among "Englischemen that speketh hit aright"—may direct us in the search for the older forms of our familiar English, and enable us often to select between the various sounds given to the same word in different places at the present time.

Thus, when we remember that in many parts of the old British settlements in America English was almost in the position of a foreign tongue, requiring to be carefully guarded against undue change, we see that in America, even as it is now, the Englishman may seek for old forms of pronunciation which have long since died out in England itself. This is, of course, exactly the reverse of what Englishmen generally expect to find in America, and of the interpretation which they place on what they actually find. When Dickens noticed the pronunciation "air" for "are," which was commoner in America in 1844 than it is now (though it is still heard there), he took it for granted that it was a corruption. But in reality this is the old way, or rather a once widely prevalent way, of pronouncing the word; in outlying parts of England it is still very frequently heard. In like manner the strange sound of the "e" in the words "very," "American," &c., which we hear in New England and elsewhere, though not exactly the original sound, is probably nearer to it than that more usually heard in the States, and always heard in England.

We find here a sort of rule for obtaining the best information about the original character of any doubtful sound. We seek for it where the circumstances have been such that change would be least likely to occur. We can never be quite sure that no change has taken place, but we know where and how changes occur most freely and frequently, and where, on the other hand, the circumstances favour stability of pronunciation. For example, America to-day, regarded as a whole, is far less likely to show the original pronunciation of English words than one of the old colonies would have been had it retained its colonial character until now. A portion of the States where circumstances favour constant intercommunication is less likely to retain old forms than some region where the inhabitants live for the most part in the place of their birth, and neither see nor hear much of their fellow-countrymen at a distance. England itself would be the place where the ruling form of the English language would differ most from the original, precisely as the central stem of a tree extends farther from the trunk than any others. Yet in parts of England we may expect to find useful evidence of the old forms of English, while in old English literature we recognise evidence of another kind which may be exceedingly useful, if only we can ascertain just what sounds the letters employed in spelling different words were intended to represent. In Scotland, however, and in Ireland, we should have an even better chance of finding ancient forms of speech and of pronunciation, and so much the better chance as we went farther from the centres of population, to which changes introduced in the original home of the language would most readily spread.

There are some interesting considerations to which an application of this general principle (that old forms survive longest in out-of-the-way corners) seems to lead. This field of inquiry has been much less surveyed than many might imagine, who know only of the immense amount of labour which has been devoted to the study of the English language and its history. In nearly all researches into this subject, it has been taken for granted, if not actually asserted, that the language has progressed steadily from form to form. In reality, even so far as the written language, or the language of the better educated, has been concerned, this is far from representing the truth; but it is still farther from that, as regards the language spoken by the English people.

As I have said, we find at the very outset of our inquiry a difficulty arising from our inability to determine what sounds the various letters, and especially the vowels, in old books and documents were intended to represent. Spelling in old times was a free-and-easy matter. Yet we must suppose a writer, even though he altered his spelling of a word half-a-dozen times in the course of as many pages (or perhaps as many sentences), yet pronounced it always in one way. What, then, are we to understand when we find (for example) the word which we spell "great," spelled grat, grate, great, greate, gret, grete, greet, greete, grayt, grayte, and so forth, by one and the same writer, in one and the same chapter? At first it seems difficult to answer. But so soon as we remember that in the first place he must have pronounced the word in one way (except possibly that according to its position before a vowel or a consonant it may have been deprived or not of some faint trace of the sound originally represented by the final "e"), while there must have been some recognised limit in his day to the sounds which the letters a, e, ea, ee, ay, &c., could represent, we see that in this very multiplicity of spelled forms of a single word we have a means of determining both the pronunciation of words, and the force of the different letters in the spelling of the period. To take for example this particular word "great," from such evidence as the above spellings afford we may be sure the word was pronounced in the writer's time nearly if not exactly as now; and further, that while "e" represented generally in the spelling of his time the sound of "a" in "fate," "a" had already lost the "ah" sound (as in "far"), which originally belonged to it. We might be doubtful if, as in the quotation above from English of the fourteenth century, we only found the spelling "greet"; this might represent the same sound as in our word so spelled now. And in like manner "grayt" might represent a sound rhyming to "rite." Nor would "great" help us alone, for the pronunciation might have been such (so far as this spelling could tell us) as to make the word rhyme with "heat" and "feat" of to-day. But the pronunciation of "great" as at present is the only one which corresponds nearly enough with all the spellings to be admissible as the sound they were all, no doubt, intended to represent.

A single case such as this starts a long series of inquiries. If "ea," for example, represented satisfactorily in that writer's day the sound of "ea" in "great," may not other words spelled at that time with "ea," and still retaining that spelling, have been similarly pronounced? If they retained that old pronunciation until after the time when the spelling of words began to be settled as a matter of custom rather than convenience, then, though the pronunciation might change, the spelling would remain.

Let us turn to a few words thus spelled:—

We smile at Pat when he talks of the "say" and "tay," "raison" and "saison," and so forth. Doubtless it would be wrong so to pronounce these words in social converse with persons of culture. Yet when we find that these words were spelled "sea" and "tea," "reason" and "season," at a time when "e" had still its proper sound as of "a" in "fate," while "ea" did duty for a somewhat longer "a" sound, we may suspect that the Irishman of to-day simply retains a pronunciation which we have lost. This view is confirmed when we consider that *tea* is the same word which in French is represented by *thé*, almost

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equivalent to *tay*, though it must be remembered that "th" in French is not, as many imagine, precisely equivalent to simple "t"; the aspirate counts for something, as every one knows who has heard French spoken properly. I say this view is *confirmed*, not that it is demonstrated, by the French pronunciation. For we must remember that French pronunciation might have changed as much as English. The probabilities are that it would. The only reason we have for trusting rather to the French than to the English spelling is that French spelling is more uniform in significance, and if we supposed *thé* in the eighteenth century was pronounced "tee," we should have to suppose all French words spelled with "é" at that time also pronounced with the "ee" sound, which is rather more than unlikely.

We find further evidence about the word "tea," because Pope makes it rhyme with "day." Since Pope was usually careful with his rhyming, insomuch that he would spoil the grammar to keep the rhyme true (writing "begun" for "began," or *vice versâ*, and the like), this is practically decisive. We see here an undoubted case in which the sound "ay" has degenerated in England into the sound "ee."

(*To be concluded.*)

THE DURATION OF OUR COAL SUPPLY.

By W. Mattieu Williams.

I PURPOSE now to conclude this series by discussing briefly this much-vexed question. My readers must all know that very widely varying estimates have been made, some giving us but another generation or thereabouts, others a few centuries of further supply. I am about to perpetrate the extreme presumption of differing from both, and asserting that the exhaustion of our coal-fields has already commenced, is rapidly proceeding, and yet will never be completed.

This apparent paradox will solve itself by considering the conditions of the problem. We began by working the best and the most easily worked seams, and we did this at a time when most of the coal now in the course of working was inaccessible, could not be worked at all. The mere removal of the water that accumulates in most of the pits now working would have been practically impossible with the pumps or buckets of our forefathers. If we were now only able to do what they could do, our coal supplies would already have ended. With such appliances coal fuel would be dearer than wood fuel, seeing that we have already worked out the coal that was commercially within their reach.

From the very beginning, when only the outcrops were grubbed, until the present time we have been gradually working out the richest and most workable of existing seams, and are doing so still; every year's working increases the difficulty of obtaining the next year's supply, and increases its cost, unless improved appliances and means of working effect a proportionate economy. This will go on continually until the cost of obtaining home supplies is so great that it will be cheaper to import foreign coal than to work our own. The American coal-fields contain quite a hundred times as much coal as ours. China probably has nearly as much as America, and so on with other parts of the world. The principal difference between our coal wealth and that of other nations is personal rather than physical. It is not our greater supplies underground, but our greater energy in raising them to the surface and using them productively, that has placed us at the head of coal-producing and coal-using nations.

It is true that this general action of first working the best coal is not without exception. There are bits here and there that for exceptional reasons have remained unworked, as where, for instance, the getting of coal would interfere with the game preserves of Squire Mohawk, whose superior "culture" and high social rank have rendered it necessary that he should devote himself to bird-slaughtering and other blood-shedding amusements. These exceptions do not, however, practically affect the result, owing to the necessary operation of the economic law that the market value of any openly sold commodity is determined by the cost value of the most costly portion which is required to supply the demand.

As we proceed to deeper and deeper seams, a time will arrive when the cost of vertical transit from seam to surface will exceed the cost of horizontal transit across the Atlantic. In vertical cost I include not merely haulage, but all the cost connected with deep pits and deep workings. But here again we have a complication. Before this exact state of things arrives, *i.e.* when our coal shall cost more to bring it up to the pit bank than to import from other countries, there will be a long period during which it will cost less to bring coal from America to our south-western ports than to raise it from our own coal-fields and carry it to these places by rail.

People living in such places as Plymouth, Dartmouth, Portsmouth, Brighton, London, &c., and paying 20*s.* to 30*s.* per ton for coal, are apt to forget that as much as 75 per cent. of these prices are for carriage and middle profits, that the price of coal at the pit's mouth ranges even now from 5*s.* to 7*s.* per ton. There are coal seams close to the sea coast in Nova Scotia, which might, if sufficient enterprise existed there, be put on board specially-constructed ships, and delivered in our south and west coast towns, or in London, at about 15*s.* per ton. Even lower estimates have been made, and experience shows that in respect to such carriage the facts commonly fall below the estimates. Some years ago the oil masters of Scotland and North Wales (of whom I was unfortunately one) sent out a special commissioner to learn the lowest cost of importing refined petroleum from Pennsylvania to London. His estimate of total cost, including barrels, insurance, &c., was 1*s.* to 1*s.* 2*d.* per gallon. Allowing price at the wells to be 6*d.* per gallon, we felt safe to compete at 1*s.* 6*d.* I have just finished a barrel of the best water-white kerosine which I purchased last autumn *retail* in a London suburb at 6½*d.* per gallon. This includes prime cost, carriage, barrel, insurance, and two profits. I have no doubt that when the carriage of coal across the Atlantic to London becomes fully developed, the freight will be reduced to 4*s.* or 5*s.* per ton, or about half the present railway rates and truck hire from Newcastle or Durham or Derbyshire.

I also believe that the reason why this has not already occurred is merely an artificial one. It is simply because the capitalists of the United States and Canada imagine that a new country can better nourish its infant industries by excluding foreign products (even those that feed the infants) than by developing their own natural resources by the free action of natural selection.

But even when the extreme condition is fulfilled, when the average depth of the Newcastle pits is, say, 3,000 feet greater than that of the American pits near the coast, and our vertical difficulties equal their horizontal difficulties of 3,000 miles, we shall not even then cease working our coal, for by this time the Americans will be exhausting their most favourably situated and richest seams, and then both they and we will be proceeding towards the more and more costly, until at last wood fuel will be cheaper than coal at even moderate distances from the mouths of coal pits.

While this is proceeding we shall gradually drop those industries which demand the greatest supply of coal in proportion to value of result. Thus our blast furnaces, and other smelting furnaces, will be blown out. We shall cease to make crude pig iron and other crude metal, the cost of which chiefly depends on that of coal and ore, but not being addicted to the misdirection of industry by legislative interference, we shall develop our industries in the direction of higher elaborations of the raw material. One ton of watch springs demands more industry and has higher value than a thousand tons of pig iron, while the pig iron demands five hundred times as much coal for its production. Therefore by the aid of unfettered natural selection, and the survival of the fittest, the blast furnaces will be blown out, and an evolution of those industries demanding more labour, more skill, and more intelligence, and less fuel, will proceed, provided we retain those energies which at the proper time brought our coal to the surface, and created the steam-engine to pump the pits when more powerful pumps were needed, and also created railways and locomotives to carry it throughout the land when such carriage was demanded.

I have always regarded, and frequently described, the notion that our manufacturing supremacy depends on our coal supplies as a gross popular fallacy, and one which at the present day may be very mischievous if it induces us to lean upon such a rotten staff. The sooner we understand that any physical advantage in coal supply we ever possessed has already gone, the better for our future progress. It is not desirable that we should continue to be the coal-cellar of the world, nor that we should depend on the coarser industries that are so voracious of fuel.

Our old form of "manufacturing supremacy" is becoming a national curse. We import more than a million of eggs daily, and corresponding quantities of butter, cheese, fruit, and other agricultural produce. We obtain these in exchange for factory products, for goods that are hatefully produced at the cost of national degeneracy by the crowding of millions of miserable wretches into the slums of manufacturing towns, where their unhealthy work and surroundings cause them to produce stunted, scrofulous, and vicious offspring. At the same time we are extending the big factory and steam-engine system of work to our agriculture, and thereby converting into a prairie a country that should be a garden. Farming is becoming one of the lost arts in England, our so-called farmers being mere graziers, wholesale manufacturers of mere beef and mutton.

Coal worship has promoted the exaggerated use of grossness in everything; big mechanical work done by big engines in big factories, producing big incomes at one end and big union workhouses at the other. Let us endeavour to supersede these by small farms highly worked by peasant proprietors, and small workshops belonging to highly skilled and artistic artisans, with good wages all round.

King Coal must be dethroned, and with him will go his grovelling money-grubbing courtiers, to be replaced by a commonwealth of individual industrial skill and intelligence naturally fitting a small island densely populated, and with a climate so moderate in all directions that a full day's work may be done on any day throughout the year.

Let other nations do the big things, the tall work, and the coarse work—let us do the best. But we cannot step into this position at once. This progress, like that of our coal exhaustion, with which it is intimately connected, must be gradual and endless. Instead of relying on coal or iron ores or any other physical advantages, we must prepare for their declining supply by developing more reliable and enduring sources of prosperity—the intelligence of *all* the people, especially the workers. A rich man can afford to be a fool, and the nation can afford to let him play the fool provided he is a harmless fool; but not so with the industrial millions. They must be highly educated in order to do the higher work demanded under the new conditions. They determine the progress of the nation, whether it has little coal, or much coal, or no coal. If we understand this and act upon it, the gradual exhaustion of our coal supplies will be a national blessing. We shall have fewer flunkey-feeding millionaires — or, better still, none; and fewer paupers—or, better still, none; but the nation will be enriched by consisting mainly of skilful and intelligent wealth-producers sufficiently well paid to obtain rational comfort, but not sufficiently to become sensual sybarites.

EASY STUDY IN THE DIFFERENTIAL CALCULUS.

SUGGESTED BY THE "SATURDAY REVIEW."

IN my "Easy Lessons in the Differential Calculus," written specially for beginners, and rather to show them how well worth studying the Calculus is than as a treatise on that important part of mathematics, I explain in Lesson I. and illustrate by an example what is meant by "differentiation," and in Lesson II. what is meant by "integration." The particular example selected is the fall of a body under the action of gravity, so that in these two short lessons I consider only the differential coefficient of the familiar expression $\frac{g t^2}{2}$, representing the space fallen through in time t under gravity. In Lesson III. (only four pages in length) I take another simple expression ($a y - y^2$), for differentiation, "before proceeding to obtain the differential coefficients of various familiar functions." At this very early stage, *before I had given the differential coefficients of any of the simple functions* (attended to in Lessons IV. and V.), I thought it well to show how even the pre-elementary matter already dealt with could be used in solving a familiar problem or two. Having only the differential coefficient of ($a y - y^2$) available for the purpose, I was naturally somewhat limited in my choice, especially as I had barely begun to show the relations between differential coefficients and the increments or decrements of variable quantities. I selected two cases which involved the expression ($a y - y^2$) or $y(a - y)$; the first related to the rectangle between two lines of length, y and $(a - y)$, the problem being the determination of the value of y, in order that the rectangle represented in area by $y(a - y)$ might be a maximum. Every geometrician knows the problem and its answer, and half-a-dozen ways of solving it. Every algebraist knows what value of y makes the expression ($a y - y^2$) a maximum, and how to prove that this happens. But of course the illustration of the special point I was considering would be none the worse for the familiar character of the problem dealt with—perhaps rather the better. The point to be illustrated was the way in which the differential calculus can be applied to problems, which, dealt with geometrically or algebraically, require usually some special device planned to meet each case as it arises, which is true even for these very simple cases.

However, the *Saturday Review* has thought it fair to treat as follows this simple illustration, given at the very beginning of my subject, before I had dealt with the simplest of the differential coefficients, and specially described as merely a preliminary example of the method of using the differential calculus:—

Lesson III. is headed "Illustrations of the Use of the Calculus" [the reviewer might have noticed, had he cared to be honest, that

Lesson IV. is headed "Differentiating Simple Functions"; Lesson V. the same; Lesson VI., "Differentiating Composite Functions"; and that Lessons VIII., X., XI., XII., and XIII. are all devoted to "Illustrations of the Use of the Calculus." However, it suited him better to describe Lesson III., preceding even the simplest differentiations, as though it were the only lesson relating to the use of the Calculus]. When we turn to see how Mr. Proctor applies this great engine, we find only two little problems, neither of which requires anything of the sort. The first is a question about a straight line. In this there is nothing wanted beyond the fifth proposition of Euclid's second book to do easily in two lines or three, what Mr. Proctor occupies a printed page with. Need one have a telescope fetched, tripod and all [strange idea this man has about an astronomer's telescope] to look at the clock on the chimney-piece? The second problem or "illustration" is equally simple, and equally undeserving of having so great an engine set in motion; in fact, it is easily shown to depend on the same proposition of Euclid when a rectangle is interpreted algebraically, and can thus be done more quickly than by Mr. Proctor's mode [meaning "method," it may be presumed].

As a matter of fact, the geometrical problem would not require the second book of Euclid at all, though it could be given as a corollary to the problem mentioned by the *Saturday Reviewer*. The geometrical solution might, for example, run as follows, without going beyond Book I.:—

Let A B (fig. 1) be the line, C its bisection, D a point in A C. Complete the square A C F E, and the rectangle

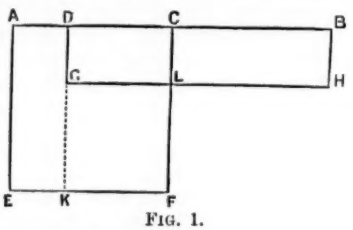

FIG. 1.

D B H G, having the side B H equal to A D. Produce D G to meet E F in K. Then the rectangle A K is equal to the rectangle C H, since A D=B H and A E=A C=C B). Add G C. Then the rectangle G B is equal to the figure E D L, or is less than the square E C. Q.E.D.

Algebraically, the proof of the proposition that $(a\,x-x^2)$ is greatest when $x=\frac{a}{2}$ can hardly escape anyone who has ever solved a quadratic equation. It runs simply thus:—

$$a\,x-x^2=\frac{a^2}{4}-\left(\frac{a}{2}-x\right)^2$$

which is manifestly greatest when $x=\frac{a}{2}$. Q.E.D.

Now my page of printed matter (really two-thirds of a page, but that is near enough for the *S. R.*) gives not only the solution of the problem, but an explanation of the principle on which the application of the differential calculus to such problems depends—this being what I desired to show, not how to solve a problem which involves in itself no difficulty whatever. "Mr. Proctor's mode" or method consisted in showing at the very beginning of his little book how the differential calculus is applied to problems of a certain class. (For this a page would not have been too much, though little more than half a page sufficed.)

Albeit, if one can imagine a mathematician in any momentary doubt as to the value of x which will make $(a\,x-x^2)$ a maximum, one would certainly expect him to apply the differential calculus, because this would save him all trouble. Antecedently it would be doubtful in most cases of the kind whether a geometrical or algebraical method could be lit upon easily—and it may be remarked in passing that when we are told that this or that problem, readily solved by the differential calculus, can be solved geometrically or algebraically, we may generally be sure (if it has any difficulty in it) that the geometrician or algebraist has first solved it by the calculus, or seen some one else's solution, and has then inquired how the known result could be obtained geometrically.

A mathematician proceeding on the sensible plan of applying the only method which is sure and easy, without troubling himself about its being a "great engine" (which is sheer nonsense), would have easier work than either the geometrician or algebraist, easy though (as we have seen) their task would be. The problem is:—"If $y=a\,x-x^2$, when is y a maximum?" The "great engine" does the work thus (the engineer knowing that for any expression to be a maximum its differential coefficient must vanish):—

$$\frac{d\,y}{d\,x}=a-2\,x=o\;;\;\;\therefore\;x=\frac{a}{2}.$$

Of course the easier the example selected, the less favourably the work of the "great engine" compares with the work of any smaller engine capable of effecting it. Still, the above is not *very* hard work; and be it noticed that it involves much less thought than even the simple geometrical and algebraical methods presented earlier, little though the thought be that they require. (We see that even a *Saturday Review* mathematician can puzzle out one of those solutions, though, to be sure, he makes a large fuss over his small achievement, and his solution is far from being even the best of its kind—always supposing it original.)

This particular example illustrates the use of the "great engine" ("I thank thee," *S.R.*, "for teaching me that word") quite as well as one I give further on—in Lesson VIII.—which, treated as a geometrical problem, would be more difficult. (I would back it to beat the *Saturday Reviewer*, though I think—but cannot be sure till I have tried—that a geometrician would not take long over it. I will try presently.) It is the problem of determining the greatest cone which can be inscribed in a sphere of radius r. Here the solution by the differential calculus runs easily and smoothly as follows:—

Taking x for the height of the cone, we get for its volume (y) the expression

$$y=\frac{\pi}{3}\,(2\,r\,x^2-x^3)\,;$$

whence $\frac{d\,y}{d\,x}=\frac{\pi}{3}\,(4\,r\,x-3\,x^2)=o$ (for a maximum or minimum).

So that either $x=o$, giving obviously a minimum,

or $x=\frac{4\,r}{3}$, giving the required maximum.

As some readers may like to see how this problem is to be solved geometrically, I give the solution in that way,

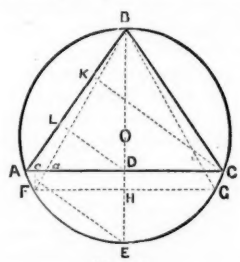

FIG. 2.

fearing lest the weakling mathematician of the *Saturday Review* should waste a month of his valuable time in vainly attempting to find one:—

Let A B C (fig. 2) be a section of the maximum cone through O, the sphere's centre; B D, the cone's height.

Let F B G be the section of a cone, having the height B H very little greater than B D. Let F B, A C, intersect in a, and draw F c perpendicular to A a. Then obviously A a F is ultimately a triangle similar to B C A. [The angle A a F=angle B a C=ult. angle B A C; and angle a A F= angle A B C.] Draw C K perpendicular to A B, corresponding, in the larger triangle, to F c perpendicular to A a in the smaller.

Now, the right-angled triangles F c a and B D a being similar, we have

$$\text{F}c : \text{B D} :: ac : a\text{D};$$

$$\text{whence F}c \,.\, a\text{D} = \text{B D} \,.\, ac.$$

$$\therefore \text{F}c \,.\, (a\text{D})^2 = \text{B D} \,.\, ac \,.\, a\text{D} \quad (1)$$

But if the cone B A C is a maximum, the increment in passing to the cone B F G must be equal to the decrement; whence ultimately (when A D=c D=a D, &c.)

$$\pi \,.\, \text{F}c(a\text{D})^2 = \pi \frac{\text{B D}}{3} \,.\, \text{A}a \,.\, 2a\text{D} \qquad (2)$$

Comparing (1) and (2) we see that for a maximum we must have—

$$ac = \tfrac{2}{3}\text{A}a$$

or

$$\text{A K} = \tfrac{2}{3}\text{A B} = 2\text{K B}.$$

Join E A and draw D L perpendicular to A B, bisecting A K in L (because A D=D C). Then since L D and A E are parallel and B L=$\frac{2}{3}$ A B

$$\text{B D} = \tfrac{2}{3}\text{B E} = \tfrac{4}{3}\text{B}o;$$

the same result as by the "great engine." But the "great engine" did the work more easily.*

The *Saturday Review* having displayed its profundity thus effectively, proceeds in the following strain:—

> In the table of contents, we were astonished to find the heading "Elliptic Integrals," [In reality the heading is "Elliptic and Hyperbolic Integrals," but to have mentioned this would have baulked the *S. R.'s* attempt at sarcasm.] but on looking up the chapter found not a word about them, as ordinarily understood, but only a proposition about finding the area of an *ellipse* by integration. Must we conclude that the author did not know what the phrase meant? [The *S. R.* naturally leaves it to be understood that we must come to this distressing conclusion.]

Now if I were given to betting, I would be prepared to offer a tolerably large wager that the writer of this *critique* (save the mark!) does not in the least know what an "elliptic integral," as commonly understood, really is, or why it is called an "elliptic integral," or for what purposes the so-called "elliptic functions" were discussed by Legendre. The way in which he emphasises the word "ellipse" (for the italics are his) shows this clearly enough. Evidently that sarcastic emphasis would have come in quite as effectively if he had had to say that he only found a proposition about rectifying the arc of an *ellipse* by integration—though such a proposition would have related unquestionably to "elliptic integrals" as commonly understood.

The fact is that the phrase "elliptic integrals," as commonly used, is a convenient misnomer. In the rectification of an ellipse (centre as origin of co-ordinates, major axis 1, and eccentricity e), we obtain the equation—

$$s = \int \sqrt{\frac{1-e^2x^2}{1-x^2}}\, dx \text{ (where } s \text{ represents the arc)},$$

and putting $x=\sin\theta$, so that $dx=\cos\theta\, d\theta$, we get

$$s = \int \sqrt{1-e^2\sin^2\theta}\, d\theta.$$

* Here are two easy problems which either the beginner in the Differential Calculus or the geometrician can solve: (1) Determine the maximum cylinder which may be inscribed in a given sphere. (2) Determine the cylinder of maximum surface which may be so inscribed.

Now the term "elliptic integrals" is applied conveniently, but not correctly, to expressions of the form,

where $\int f(x, \text{X})\, dx$

$$\text{X} = \sqrt{a+bx+cx^2+dx^3+ex^4}*$$

d and e being not both equal to zero. Such integrals can be classified into others, of which all not expressible by algebraic, logarithmic, or inverse trigonometrical functions, have one of the three forms:—

$$\text{(i)} \int \frac{d\theta}{\sqrt{(1-c^2\sin^2\theta}} \qquad \text{(ii)} \int \sqrt{(1-c^2\sin^2\theta}\, d\theta \qquad \text{and}$$

$$\text{(iii)} \int \frac{d\theta}{(1+a\sin^2\theta)\sqrt{(1-c^2\sin^2\theta}}$$

the integrals being all taken between the limits θ and o.

The second form is that already obtained for the rectification of the arc of an ellipse; and for this reason, by no means a perfect one, these integrals are all, for convenience, called "elliptic integrals."

But if mathematicians may for convenience call several orders of integrals "elliptic" because one among them really is elliptic, as appearing in dealing with the rectification of the ellipse, they are surely free if it suits their convenience (as it did mine in the present case) to call certain integrals "elliptic" which are really elliptic, as appearing in dealing with the quadrature of the ellipse—especially if (as I did) they prevent all possibility of mistake by combining with the term "elliptic," thus used, the term "hyperbolic" similarly used, because it relates to an order of integrals appearing when we are dealing with the quadrature of the hyperbola.

I wanted a convenient heading for a chapter on integrals relating to the ellipse and hyperbola, so I called them "elliptic and hyperbolic integrals." I knew that on the one hand the readers for whom I was writing could not be in any way misled by this nomenclature, especially as the chapter itself sufficiently explained the use of the words. I was equally well assured that no mathematician acquainted with the technical (but scarcely correct) use of the phrase "elliptic integrals" could be for a moment misled, if by any chance he looked over my simple pages. And although the idea did occur to me that critics of the *S. R.* class—neither learners nor learned—might cavil, that did not in the least trouble me. I knew that on the one hand I was certain to encounter cavillings of that sort, and that on the other I should know well how to treat them, and should even be able to apply them to a useful purpose, as I am now doing.

That the notice I have been dealing with is feeble and spiteful may be explained by the fact that it appears in the paper called the *Saturday Review*—by some (by others less euphoniously). Does this remark sound unmannerly? For my own part, I think it does. I withdraw it. I was only trying an experiment. The *S. R.* says that the defects (invented) which it pretends to recognise in my two small and unpretentious books, "First Steps in Geometry" and "Easy Lessons in the Differential Calculus," "may be explained by the fact that they consist of papers written for the magazine called KNOWLEDGE." I wanted to see how such a remark applied even to the *Saturday Reviler* might sound. I cannot think that it sounds well.

As for the remark thus rudely made by the *S. R.*, it chances to be untrue—no very strange chance of late, when the *S. R.* is in question. The substance of the two books dealt with was not written for KNOWLEDGE, though it appeared in KNOWLEDGE. (The *Saturday Review* never could

* If under the radical higher powers of x appear than the fourth, the integrals thence deducible are called "ultra-elliptic" or "hyper-elliptic."

be logical, even in its better days.) Both works were written long before KNOWLEDGE began its career. They were submitted by Messrs. Longmans to the Rev. Mr. Griffin, of Ospringe, a Senior Wrangler of long standing and well known as a mathematician of great power. After carefully examining both works, he recommended Messrs. Longmans to accept them for publication, and accordingly an agreement was drawn up in regard to these two works, and this agreement—which lies before me as I write—bears a date preceding the issue of the first number of this magazine. The effort of the *S. R.* to be disagreeable was well tried, however.

THACKERAY AND THE "SATURDAY REVIEW."

"HERE is my *Saturday Review*, and in an American paper subsequently sent to me, I light, astonished, on an account of the dinners of my friend and publisher, which are described as 'tremendously heavy,' of the conversation (which does not take place) and of the guests assembled at the table. I am informed that the proprietor of the *Cornhill*, and the host on these occasions, is 'a very good man but totally unread,' and that on my asking him whether Dr. Johnson was dining behind the screen, he said, 'God bless my soul, my dear sir, there's no person by the name of Johnson here, nor any one behind the screen,' and that a roar of laughter cut him short. I am informed that I have touched up a contributor's article; that I once said to a literary gentleman, who was proudly pointing to an anonymous article as his writing, 'Ah! I thought I recognised your hoof in it.' . . . Then the graceful writer passes on to the dinners, of which it appears the editor of this magazine 'is the great gun, and comes out with all the geniality in his power.' Now suppose this charming intelligence is untrue. Suppose the publisher never made the remark beginning, 'God bless my soul, my dear sir,' &c., nor anything resembling it? Suppose nobody roared with laughing. Suppose the editor of the *Cornhill Magazine* never 'touched up' one single line of the contribution which bears the mark of his hand? Suppose he never said to any literary gentleman 'I recognised your hoof' in any periodical whatever? . . . Suppose this back door gossip should be utterly blundering and untrue, would any one wonder? Ah! if we had only enjoyed the happiness to number this writer among the contributors to our magazine, what a cheerfulness and easy confidence his presence would impart to our meetings! . . . As dear Sam Johnson sits behind the screen, too proud to show his threadbare coat and patches among the more prosperous brethren of his trade, there is no want of dignity in *him*, in that homely image of labour ill rewarded, genius as yet unrecognised, independence sturdy and uncomplaining. But Mr. Nameless, behind the publisher's screen uninvited, peering at the company and the meal, catching up scraps of the jokes, and noting down the guests' behaviour and conversation—what a figure is his! *Allons*, Mr. Nameless! Put up your note-book; walk out of the hall, and leave gentlemen alone who would be private, and wish you no harm."—Thackeray in the *Roundabout Paper* "On Screens in Dining-rooms."

[This paragraph, as it stands, would give an unfair idea of Thackeray's strictures. The *Saturday Review* in 1860 was a powerful paper. Those were the best days mentioned by Matthew Arnold in his praise of the American paper *The Nation*. In the article quoted Thackeray speaks of the *Saturday Review* as piquing itself ("and justly and honourably in the main") on its gentlemanly as well as its literary character. It was then, moreover, usually manly, though it was always characterised by the weakness indicated by declining ever to correct or admit mistakes, to which, in common with all things human, it was liable. We find even a man of science like Darwin, though remarking with reference to a *critique* in its pages that "One cannot expect fairness in a reviewer, so I do not complain &c.," recognising real worth in a *Saturday Review* criticism of his "Origin of Species." (This seems so strange, *now!*) It is true that the criticism (*not* the *critique* as a whole), though true, did "not at all concern the main argument." Still the change indicated by such evidence of what the *S. R.* once was is startling, even to us who have been able to note its progress. Imagine a paper once so conducted that a Darwin could learn a lesson (on a point of detail) from its pages, reduced to such a point that Sir William Jenner should be spoken of by one of its "young buccaneers" as the inventor of vaccination!—ED.]

BRITISH AND IRISH FAIRIES.

BY STELLA OCCIDENS (MARY PROCTOR).

When Puck appears and spins him round,
And glides amid the dance,
Behind him, with him to rejoice,
Hundreds of sprites advance.

AMONG the superstitious folk in the North of England it is supposed that fairy elves haunt the woodland glens, and on moonlit nights they are to be seen dancing a merry roundelay* on the green sward. If any one has the courage to run in their midst and steal the drinking-glass they use at these festivals, it will bring good luck, "supposing he can carry it across a running stream." At Edenhall, in Cumberland, a butler, whilst drawing water at a well, was very much surprised at seeing some of these little beings amusing themselves on the grass. They had left their drinking-glass upon the margin of the well, and he ran away with it, though hotly pursued by the fairies. Finally he outran them, and they vanished crying:—

If that glass do break or fall,
Farewell the luck of Edenhall.†

Oberon, king of Fairyland, and his wife Titania, held many a moonlight revel in days of yore. On one occasion the tiny royal pair had a dispute, but Oberon called his son Puck to his assistance, and peace was soon restored in Fairyland. Puck, or Robin Goodfellow, was a domestic sprite, like the Scandinavian *nisse* and the Scotch brownie. He was famous for his merry pranks, so much so that his father threatened to punish him, and the little imp ran away from home. He wandered through the woods, and presently feeling tired, he lay down on the ground and fell asleep. When he awoke he found a scroll lying on the ground. It had been placed there by his father Oberon, and contained verses written in letters of gold, telling him that he could have all he desired,‡ and the power of changing

* [The word *roundelay* signifies a round dance as well as a song in which the first strain is repeated. The English spelling alters the true word *rondelet*, so as to suggest the idea that a lay or song is necessarily signified.—ED.]

† This very nearly happened, for one day the Duke of Wharton, having taken a drink out of the magic glass, carelessly let it fall, but the butler caught it in his napkin.

‡ The earliest recorded instance of agony advertising: "If Puck will return to his distressed family all will be forgiven and he shall do as he pleases."

himself into any shape, but he was not to harm the needy nor the honest, but rather to help them. Robin often took advantage of his power, and delighted in playing tricks. One day he went to a wedding as a fiddler, and caused quite a commotion during the evening by putting out the lights. All being in darkness, "hee strucke the men goode boxes on the eares." Each thought it was the other, and they began fighting, at which the naughty elf did laugh right merrily. The women also began to scratch each other like so many wild cats, and it was some time before peace was restored. At supper-time Robin once more disgraced himself by turning himself into a bear, and frightening all the people away. Being both hungry and greedy, he ate all the supper provided for the evening. Sometimes he was very good-natured, and would help the maids with their work—that is, if they left out some cream for him at night.

In West Cornwall, among the coal mines, there are harmless little elfish beings called Pixies, Spriggans, and Knockers. The latter are supposed to be the souls of the Jews who crucified Christ, and were sent by the Romans to work as slaves in the tin mines. They haunt the richest mines, and the miners have heard them knocking and singing underground, which is a sure sign of good luck. These little beings are very ugly, and apt to be spiteful. One day a man named Tom Trevorrow heard the Knockers just before him whilst he was working underground, and he roughly told them "to be quiet and go," upon which a shower of stones fell suddenly around him. Not only did this give him a dreadful fright, but from that day he had such bad luck that he had to leave the mine.

The Piskies are said to be half-witted people who have died, when they were not good enough to go to heaven. They go about in parties, and delight in mischief. On gloomy nights they lead people a sad dance, over hedge and ditch, led by

> Jack o' the lantern ! Joan the wad,
> Who tickled the maid and made her mad.

One night a Polperro lad was returning home across the fields, when he heard a chorus of squeaking voices saying, "I'm for Portallow Green," and in a moment he was surrounded by a throng of laughing piskies. He followed them, until they cried, "I'm for the King of France's cellar." He suddenly found himself in a large cellar, and joined his mysterious companions in tasting the richest wines. They strolled through the palace, and the lad "could not resist the temptation of pocketing one of the rich silver goblets from the table in the dining-hall. This all took place in five minutes. Then a signal was given, and in a moment he was whisked home with the silver goblet, to prove the truth of his tale.

Not long ago a woman of Mousehole (a village near Penzance) saw [or said she saw] troops of small people, not more than a foot and a half high. They would come out of a hole in the cliff on moonlight nights, but would scamper back again if anyone came near them. Mothers often told their children that if they went under cliffs by night, the small people would carry them to "Dicky Danjy's Hole." These little beings will thresh the farmer's corn, and do the servants' work for them at night. But should anyone notice them, or try to reward them for their services, they leave the house for ever, saying*—

> Pisky fine, Pisky gay,
> Pisky now will fly away !

The same occurs among the Irish fairies; and Shirley Hibberd relates an amusing story told by an Irish servant from Galway. Her father was a blacksmith, who had won the goodwill of the fairies by helping benighted travellers. If he left any work in his smithy overnight they would finish it for him. The family were often aroused by hearing "vigorous puffing with the bellows, and hammering on an anvil"; but the fairies always replaced the tools they had used in the night, and left the smithy in perfect order. If the fairies were disturbed in their work there was trouble. One evening the blacksmith went to the smithy for some medicine he had left on a shelf. The good people had just begun their work, but his entrance put them to flight. As a result a series of misfortunes took place. The following day "a black pig died, little Tike took the measles, and for several nights the people in the house were kept awake by a noise like peas and pebbles being thrown at the window." * These fairies dwell in rocks, and are so small and dainty "that a dewdrop trembles beneath their light weight." In the fairy legends of the South of Ireland, Crofton Croker tells us that "they are only a few inches high, and almost transparent."

The Banshee watches over a particular family; the Cluricane is an evil elf who takes the form of an old man, and knows where to find hidden treasures; and the Phooka is a diabolical spirit who sometimes appears as an eagle or a black horse, and hurries any one he gets hold of to destruction.

Fairies that are only seen on moonlight nights are laughter-loving mischievous sprites. A story is told about a carpenter, called Davy Hanlan, who declared that he came across some of these beings. He was on his way home, and, worn out with the day's work, he rested on a bridge. The moon had risen, and the hills and valleys were bathed in a silvery haze. The lights and shadows were so exquisitely blended that it appeared "to be the work of an enchanter's wand." Suddenly Davy heard voices, and "saw a group of dwarfish beings emerging from the gloom, and coming rapidly towards him, along the green marsh that borders Maudlin stream." As they approached the bridge they cried out, "Where is my horse? Give me my horse." In the twinkling of an eye they were all mounted. Davy also said "Give me my horse," and he found himself astride a piece of wood. Gliding smoothly through the air, the whole party arrived in a large city just as the bells had tolled the "magic hour of midnight." They went from house to house, trying all the doors until they came to one which had a large wine-cellar. The door had been left open, so they did not hesitate to enter and make themselves perfectly at home. They had a merry time: wine-bottles were broken, bungs flew out, and the walls re-echoed their peals of laughter. Davy looked on in wonder, and, thinking that he might as well take his share in the fun, he asked a rather agreeable fairy if he could not have some wine, as he was very thirsty. "When I shall have done," said the fairy, "I will give you this goblet, and you can drink." She had scarcely handed it to him, when the leader gave the word of command :—

> Away, away, my good fairies away !
> Let's revel in moonlight and shun the dull day.

They all mounted their horses, and, in the twinkling of an eye, Davy found himself on the bridge again, with the silver goblet in his hand.† Tory Island, Donegal, is a favourite haunt of the good people, "and no Toryite will go out alone after dark. Till lately there lived at Killult a woman who used to be carried off by the fairies. One dark night, when they were out looking for her with torches, Owen Kelly of Molin rescued her: she was in the grasp of

* *Folk-Lore Journal*, vol. v., part iii., p. 185.

* *Notes and Queries* for 1852, vol. vi.

† *Notes and Queries* for 1853, vol. vii., p. 62.

XUM

a little man with a red cap, who disappeared as he came up."*

The fairies also steal little babies, leaving ugly, deformed changelings in their place. This practice is referred to by Chaucer, Drayton, Shakespeare, and Hogg. The latter wrote the ballad of Kilmey, about a little girl who was spirited away to Fairyland, and never seen again. The fairies in Scotland have the same uncanny trick. The ballad of Tamlane relates the adventures of a little boy who had been stolen by the fairies, but was finally rescued. The capture took place in Selkirk in the following way. It was Hallowe'en, a time when all fair maidens are afraid to venture out lest the fairies should capture them. A lassie named Janet, the fairest of all her kin, was braver than the rest. When night came she walked to a well in Cauterhaugh, where the fairies held their revels. Her little sweetheart, Tamlane, had been stolen by the queen of the fairies when Janet was a little girl, and she always hoped to meet him again. When she arrived at the well she saw a milk-white steed which she recognised as Tamlane's. She waited patiently, plucking roses meanwhile :—

She hadna pu'd a red, red rose,
A rose but barely three,
When up and starts a wee, wee man
At Lady Janet's knee.

This was Tamlane, who assured her of his constancy to her during his long absence, and made a solemn vow to wed her, but on certain conditions. She had to wait for him till midnight at Miles Cross, for at that time all the fairies would pass by. She would know her sweetheart by his milk-white steed and the gold star on his forehead. As he passed by she had to clutch hold of him and hold him fast, for he would be changed into a snake, a dove, and a swan, though finally resuming his own shape.

Gloomy, gloomy, was the night, and eerie was the way,
As fair Janet in her green mantle, to Miles Cross did gae,
There's haly water in her hand, she cast a compass round ;
And straight she sees a fairy band, come riding o'er the mound.

All happened as Tamlane predicted, and Janet won him for her own, to the great grief of the fairy queen and her band, with whom he had become a great favourite.

The Scottish elves have the same traits as the Irish, and are divided into Cluricanes, Kelpies, Spunkies, Brownies, and others. A great resort of the more fiendish among these beings was Mucklestane Muir,† and rings are still pointed out " on which neither grass nor heath ever grow, the turf being as it were calcined by the scorching hoofs of the diabolical partners." The Brownie is a domestic sprite, somewhat like the being mentioned in the charming ballad of the Count of Kildare :—

Brown dwarf that o'er the moorland strays,
Thy name to Kildare tell ?
The brown man of the muirs who stays
Beneath the heather bell.

GIGANTIC FOSSIL TURTLE.—The remains of a gigantic fossil turtle have been discovered in the middle pliocene strata of Perpignan, and the creature has just been described by the distinguished palæontologist, M. Gaudry, before the Paris Academy of Sciences. The shield or carapace of the reptile was over four feet long, so that it was equal in size to the Madagascar fossil turtles. M. Gaudry considers that the survival of this great turtle down to the mid-pliocene period (shortly before the glacial epoch commenced in the Northern Hemisphere) shows that the south of France must have enjoyed a warm climate even then.

* *Folk Lore Journal*, vol. v., part i., p. 68.
† Sir Walter Scott, " The Black Dwarf."

BACON'S OWN CIPHER.

THE *Pall Mall Gazette* has done good service in calling attention, in an article entitled " The Mammoth Mare's Nest," to the way in which Mr. Ignatius Donnelly has blundered over Bacon's real cipher, while pretending to have discovered, through his exceptional profundity, a cipher which has never had any existence. In the following passage that paper gives a correct account of Bacon's well-known five-letter cipher (which anticipated in principle the Morse alphabet), and of Mr. Donnelly's foolish blundering over it—which would discredit an intelligent ten-year-old schoolboy. It is to be noticed, however, that the examples of the use of the cipher are not really taken from the " De Augmentis," but from one of the translations—Bacon's Latin Alphabet being altered into English (with W), and his direct quotation from Cicero (*Ego omni officio ac potius pietate erga te*, &c.) being translated. But this, while indicating the quality of Bacon's cipher in being able, as he said, to indicate *omnia per omnia*, brings out in a very striking way Mr. Donnelly's ignorance of Bacon's real work, and the stupidity of his feeble attempt to puzzle out a perfectly plain problem already fully and most lucidly solved by the writer whom he pretends to expound. Nothing funnier, perhaps, has ever been heard of in paradoxical literature than Mr. Donnelly's shorn return from his wool-gathering expedition, unless it be the splendidly big bull he has perpetrated in striving to prove that Bacon most laboriously concealed what he was most anxious to disclose. [Not even Bacon's acumen could have foreseen the appearance in the world of such a genius as Detractor Donnelly.]

Says the *Pall Mall Gazette* :—

In order to illustrate Bacon's familiarity with the principles of secret writing, Mr. Donnelly gives an account of the famous five-letter cipher, quoting from the English translation of the " De Augmentis." The key he gives quite correctly, and to make clear his error we must reprint it :—

A—a a a a a	...	B—a a a a b	...	C—a a a b a
D—a a a b b	...	E—a a b a a	...	F—a a b a b
G—a a b b a	...	H—a a b b b	...	I & J—a b a a a
K—a b a a b	...	L—a b a b a	...	M—a b a b b
N—a b b a a	...	O—a b b a b	...	P—a b b b a
Q—a b b b b	...	R—b a a a a	...	S—b a a a b
T—b a a b a	U & V—b a a b b	...	W—b a b a a
X—b a b a b	...	Y—b a b b a	...	Z—b a b b b

The method of applying this is to choose two different alphabets (for example, Roman and italic) and then to construct [or rather to employ, for no construction is needed] a sentence containing five times as many letters as the message you wish to convey, writing those which represent *a* in one alphabet and those which represent *b* in the other. To quote the example given by Bacon (converted into English), suppose that the message to be conveyed consists of the single word FLY. This is represented by the sentence, " Do not go till I come," written thus :

" D o n o t	g o t i l	*l* I *c o* m	e."
a a b a b.	a b a b a.	b a b b a.	
F	L	Y	

(The final *e* is superfluous.) All this Mr. Donnelly quotes from Bacon, evidently without understanding it, for *he fails to note that the whole secret of the thing lies in the two alphabets*, distinguishing the letters which represent *a* from those which represent *b*. He prints the whole cipher-sentence in small capitals, and continues his quotation thus :—" I add [says Bacon] another example of the same cipher—of the writing of anything by anything. The interior epistle for which I have selected the Spartan despatch, formerly sent in the *Scytale* : ' All is lost. Mindarus is killed. The soldiers want food. We can neither get hence nor stay longer here.' (*Perditæ res. Mindarus cecidit. Milites esuriunt, neque hinc nos extricare, neque hic diutius manere possumus.*) The exterior epistle taken from Cicero's first letter, and containing the Spartan despatch within it :—

" In all duty, or rather piety, towards you I satisfy everybody

except myself. Myself I never satisfy. For so great are the services which you have rendered me, that, seeing you did not rest in your endeavours on my behalf till the thing was done, I feel as if my life had lost ALL its sweetness, because I cannot do as much in this cause of yours. The occasions are these: Ammonius, the king's ambassador, openly besieges us with money, the business IS carried on through the same creditors who were employed in it when you were here, &c."

Here Mr. Donnelly closes his quotation and comments as follows: "I have capitalised the words *all* and *is*, supposing them to be part of the sentence, 'All is lost,' but I am not sure that I am right in doing so.* The sentence ends as above and leaves us in the dark."

Truly Mr. Donnelly is very much in the dark. To any one reading the quotation from Bacon by the light of ordinary commonsense, it is clear that the passage from Cicero's letter should be printed in two alphabets; and on referring to the original (ed. 1857-58, vol. iv., p. 445) we find that this is the case. It happens that in this edition (and doubtless in that quoted by Mr. Donnelly) the printers, instead of using Roman and italic founts, have used two different founts of italics, so that the distinction does not at once strike the unpractised eye. It becomes obvious after a moment's examination, but this Mr. Donnelly has not bestowed upon it. The passage from Cicero reads thus in Bacon (or rather is thus given by the careful translator):—"In all *duty* or *rather* piety *towards* you *I satisfy everybody except myself. Myself* I never *satisfy*. For *so*," &c., &c. Substitute *a* for the Roman letters and *b* for the italics, divide into fives, and apply the above key, and it will be at once clear that these 85 letters represent the 17 letters of "All is Lost. Mindarus." The reader, if he pleases, can write out the rest of the passage for himself; noting, however, that Bacon, that is, his translator, spells "endeavours" with a "u" and that the "my" in "I feel as if my life" is interpolated by Mr. Donnelly.

If the rest of Mr. Donnelly's cryptographic inspirations are as futile as the idea of "capitalising *all* and *is*," Shakespeare's laurels are pretty secure. *The man who fails to understand Bacon's explanation of a perfectly simple cipher is scarcely the guide one would choose to follow through a labyrinthine cryptogram.* If Mr. Donnelly can see through a millstone, he should surely be able to see through a crystal; yet Bacon's perfectly lucid exposition leaves him, confessedly, "in the dark." Unless his vision improves miraculously as he goes on, we fear that the world's judgment of his theory will be summed up in the word—but no; as a little exercise for Mr. Donnelly we will put it in cipher, thus:—

Chr*o*n*o*n*h*o*t*o*n*th*o*l*o*g*o*s.†

AN UNDECIPHERABLE CIPHER.

By RICHARD A. PROCTOR.

CRYPTOGRAMS being in fashion, I will describe a cipher of my own invention—possibly it may have been thought of before, but not to my knowledge—which is, so far as I can see, altogether undecipherable without the key.

The correspondents first prepare a table, whereof each retains a copy, containing twenty cipher-keys, such as the following:—

17. MALIKRESTUZ—2324312412031
1 2345 67890.

All, of course, are to be different, except that under the eleven letters there are always the numbers 1, 2, 3 . . . 9, 0, and a full stop. Suppose now a message to be forwarded runs as follows—"I will start at seven on Friday morning." The successive words of this message contain 1, 4, 5, 2, 5, 2, 6, and 7 letters respectively. The letters in the 17th key-word corresponding to these numbers are respectively M, I, K, A, K, A, R, and E—which, therefore, followed by Z to indicate a full stop, must be given at the beginning of the cipher-message. The words of the message are to be dealt with as follows by means of the key-number 2324312412031. Take the word "morning"—for *m* the *first* letter write *o* the 2nd letter after *m* in the alphabet, because 2 is the *first* digit in the key-number; for *o* the *second* letter write *r*, the 3rd following letter in the alphabet, because 3 is the *second* digit in the key-number; for *r* the *third* letter, write *t*, the 2nd letter following *r* in the alphabet, because the *third* digit in the key-number is 2; and so on, writing for *n* the 4th following letter *r*; for *i* the 3rd following letter *l*; for *n* the 1st following letter *o*; and for *g* the second following letter *k*, because the 4th, 5th, 6th, and 7th digits of the key-number are respectively 4, 3, 1, and 2. Thus the word "morning" becomes altered into *ortrlok*. All the words of the message are to be dealt with in this way, which with a little practice becomes very easy, and all the cipher-words thus obtained as well as the key-letters, *mikakarez*, are to be written as one long word. The message then, thus dealt with, appears in the following form:—

17. *mikakarezkylnpuwcvwcwuhxkqqqhukhhzortrlok.*

The interpretation is quite easy for the correspondent, though absolutely out of reach of any into whose hands the cryptogram may fall. He turns to the key-word and number opposite 17 in his list, and noting that *z* is the stop letter, recognises *mikakare* as meaning that the successive words of the message contain 1, 4, 5, 2, 5, 2, 6, and 7 letters, so he divides up the letters following the first *z* as follows—

k|ylnp|uwcvw|cw|uhxkq|qq|hukhhz|ortrlok.

He then applies to each of these cipher-words the key-number, taking the alphabet backwards as many letters from *k*, *y*, *n*, *l*, *p*, &c., as the several digits of that number require. Thus *k* gives *i*, the second letter before *k* in the alphabet; and we thus get the first word *I* of the message; the four letters of the next word must be set back in the alphabet 2, 3, 2, 4 letters, giving for *y* the letter *w*; for *l*, *i*; for *n*, *l*; and for *p*, *l*; so that from the cipher-word *ylnp*, we get the message-word *will*. Dealing in the same way with the other cipher-words, we get the full message—"I will start at seven on Friday morning."

I should like to hear of any way by which a cryptogram on this plan could be puzzled out. Here is a cryptogram on this method, which the ingenious reader will find no difficulty in reading, being first told that the 13th key-word and key-number appear in the correspondents' lists as follows:—

13. KNUZTHELOFY—201534012320
1 2345 67890.

The cryptogram is—

13. *uozznzyneumnpboidhgirpbhrproosjvooosj.*

I wrote this in 80 seconds.

The way to write a message quickly is to deal with it as follows:—Suppose the message to be "We are prepared to act," the 13th cipher-key, given above, being employed. Write down the message thus:—

2 3 8 2 3
We are prepared to act.
20 201 20153401 20 201

Then write down 13 for the cipher-number, *nulnuy*, from the key-word, using the numbers 23823 written above the

* The fun of this is partly lost when the English version is followed. By sheer accident the words capitalised by Mr. Donnelly occur both in the long passage and in the real message. In the Latin the words translated "I feel as if my life had lost all its sweetness," run "*Vitam mihi esse acerbam putem*," and in the extract from Cicero the first word (*Perditæ*) of the message does not occur at all.

† Even after reading the *Gazette* article, Mr. Donnelly will probably not see his way to the interpretation of this little cryptogram. So, lest he should find some minor mare's nest in it to weary the world with, we give the solution—

Chr*o*n	*o*n*h*o*t*	*o*nth*o*	lo*g*o*s*
aaaab	abbab	baaab	aabbb
B	O	S	H

XUM

message, then say *wxy*, writing down *y*; *e*, writing down *e*; *abc*, writing down *c*; *r*, writing down *r*; *ef*, writing down *f*; and so on, thus making the complete message:—

13. *nulnuyyecrfrrfudvefvoccu.*

The reading is similarly managed and quite easy.

This cipher is easy to write, easy to read, and cannot be deciphered. It does not fulfil the fourth condition, which Bacon notes as involved in certain cases. A message written on this system openly proclaims itself a cipher. But so does a message written on Bacon's system; for though the matter written be perfectly innocent and natural, the use of two types at once suggests that there is more in the writing than appears on the face of it.

SIMPLE MECHANICAL TRICKS.

(*Continued from page* 179.)

IN the following trick (or experiment) the law involved is that the centre of gravity of a body tends always to seek the lowest possible position.

Provide two equal straight bars of any convenient dimensions, a roller, shaped like an ordinary rolling ruler, and another roller of the form shown at R R′ in fig. 5—*i.e.*, a double cone rather elongated. Set the bars in the positions A B and A′ B′ shown in fig. 5, the ends at A resting on the surface of a table, while the ends B and B′, thrown pretty far apart, are

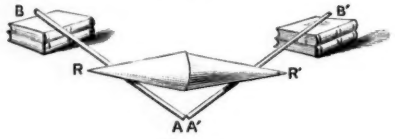

FIG. 5.

raised to such a height above the end A as to give a slight slant (two or three inches, say, in a foot) to the bars. Then set the straight roller on the slanted bars, and show that it will at once roll down to A and thence on to and upon the table—a movement which will by no means surprise the observers. Then take the double-cone roller, and making some remarks about modifying the action of gravity, set this roller on the inclined bars as in the position R R′. To the surprise of the observers, or at least of a considerable proportion of them, the roller instead of travelling down to A will seem to climb up the inclined rails, passing to B B′ and thence to the table.

You may then take up the rods and the rollers, while the spectators express their opinions upon what they have seen. After a while remark that the roller evidently climbed up the slope, out of contradiction, perhaps because the slope was too steep! Diminish the slope by taking a book from each side and set the bars again sloping from the lowered book-heaps, but taking care to set the bars this time parallel to each other, the ends A and A′ being set as far apart as the ends B and B′. Roll the straight ruler down as before, and then set the other across the bars. Those among the audience who had not been able to understand the rolling of R R′ from A A′ towards B B′ before, will see no reason why it should not roll that way as in the former experiment. But instead of this it will now roll towards A A′ just as freely as the straight roller had done.

The reason of these different movements should be obvious. When the rods are set in the position shown in the figure, the roller R R′ is really descending in moving toward B B′; for as it passes to the parts of the rods farthest apart it is supported on parts of its own surface, drawing nearer to the points of the cones, and is more lowered by this change than it would be raised, were it an ordinary straight roller, by the slight slant of the rods B A and B′ A′.

A pretty modification of this experiment may be obtained by preparing a descent beyond B B′ precisely matching the ascent from A A′ to B B′—the junction of the rods A B and A′ B′ at B and B′ with the descending rods from B and B′ to an apex like A on the further side, being close and neat. For whereas a straight roller set on either slope would pass downwards or away from B B′, the double cone roller will run up (apparently) to B B′, and then, after travelling a certain distance (the mere effect of inertia) on what looks like the downward slope, will come to rest, and, changing the direction of its motion, will pass back again over the seeming ridge line at B B′. The double cone roller will thus pass backward and forward over the top of the system of slanted rods, in apparent defiance of gravity. But in reality its centre of gravity is oscillating on either side of its lowest position.

An experiment depending on a kindred principle is illustrated in figure 6. Each represents in section: first, two stout plane boards, A B and A′ B′, hinged (or otherwise connected) at the ends A A′; secondly, two friction-rollers

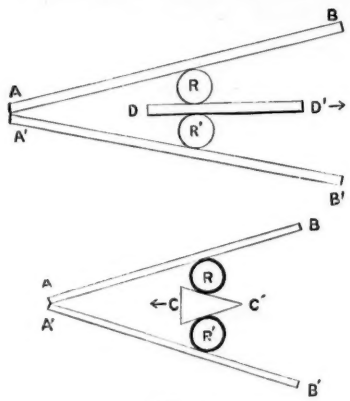

FIG. 6.

R and R′, easing the sliding of the flat board D D′ in one case, and of the wedge-shaped block C C′ in the other. In the case illustrated in fig. 6, pressing the boards A B and A′ B′ toward each other forces out the board D D′ in the direction shown by the arrow; but in the case illustrated in fig. 7, instead of the wedge C C′ being forced outwards by such pressure, it is forced inwards, as the arrow indicates, if the angle of the wedge is greater than the angle between the pressure-boards. It is easy to see the reason of this. In both cases the boards A B and A′ B′ yield to the pressure, B and B′, approaching; but whereas in one case the motion of D D′ outwards makes room for this approach, in the other the motion of C C′ outwards would bring a thicker part of the wedge between the rollers, and A B, A′ B′ would be forced more apart by this than they would be drawn together by the mere motion of the rollers outwards.

Mechanical tricks depending on inertia are often very surprising to the uninitiated. They are also very instructive. It occurs to me to notice that I was once victimised most unpleasantly by a mechanical trick of this sort played upon me by chance, not by any practical joker. I was running along a railway platform carrying a heavy valise in one hand, and a rather cumbersome but not heavy weight in the other. My foot caught against some projection in the

floor; but had I been running unweighted the accident would not have mattered in the least; in a step or two I should have recovered myself. Being loaded, however, and with weights I did not care to drop suddenly, the case was different. The inertia I had to deal with was greater, by perhaps 150 pounds, than my own. Forgetting this, and holding on to my baggage, I staggered along some twelve or fifteen paces and should have come to the ground then, had I not let my baggage go—somewhat to its detriment. It was a striking lesson in the laws of inertia.

A pretty illustration of inertia may be presented as follows:—Set up twenty draughtsmen, of the flat-faced sort, into a vertical column. Now hold a long paper-knife with one end of its horizontal face opposite the middle of one of the lowest of these flat discs, the right hand exerting a strong pressure such as would cause the knife to strike that draughtsman did not the left hand resist the pressure. Suddenly release the paper-knife so that the action of the right hand sends its end sharply against the draughtsman, striking it horizontally out of the pile. It will fly cleanly out, if the stroke is deftly delivered, and the rest of the column will remain upright, lowered only by one draughtsman's height.

Drawing a strip of paper horizontally from under a heavy coin standing on its edge, so sharply and neatly that the coin is left standing, is another pretty illustration of inertia. A crown will serve for this experiment, but the old twopenny copper piece was better.

I rather hesitate to mention that a table napkin spread on a small table as a cloth for one man's dinner can be drawn from under that dinner so deftly as to leave everything standing. For this experiment requires skill, and skill requires practice. Practising on portions of a dinner-service is apt to be expensive.

The way in which what seems a tremendous blow with a hammer can be neutralised by what seems a crushing weight is worth noticing. A man lies flat on his back and a well-filled wooden trunk or some similar weight is placed on what we conventionally agree to call his stomach. Now let a confederate seize a mallet and strike a heavy blow on the top of the trunk, a blow which delivered directly on the stomach would be fatal. The blow does no harm whatever, its force being taken up in giving a very slow and slight downward motion to the heavy weight.

A needle can be driven through a sixpence or even a shilling, if the coin is set upon a broad cork and the needle is passed into a cork set on the coin. For the needle receives the whole force of the blow along its length, and cannot break because of the side pressures produced by the cork.

A curious effect is produced if one breathes through a cone-shaped blower at a small banner hanging in front of

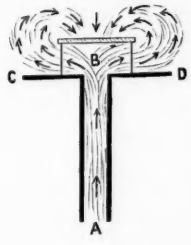

FIG. 7.

the open end. The banner waves toward the blower's mouth, not from it. If the blower be reversed so that the breath is blown in at the larger end (which, of course, must not be too large) the usual effect of blowing will take place; but in the former experiment currents of air arise, which curling outward from the rim of the larger end of the blower, cause a rarefaction of the air there, so that an indraught carrying the banner toward the blower is produced.

In like manner may be explained the fact that blowing upwards through a pipe as A B, figure 7, opening out on a flat horizontal surface, as C D, a light piece of card situate as *pp'* (kept in any convenient way at a certain distance from the orifice of the pipe) cannot be blown off, no matter how strongly the blower may force his breath through the pipe. The air blown in passes out in the direction shown by the arrows C and D, and curving round above *pp'* presses the card downwards as strongly as it is pressed upwards by such portion of the breath as reaches the under side.

The breath may be used to blow up a book—not after the *Saturday Review's* fashion, but fairly. Place a heavy book on a paper bag, like an ordinary flour bag, leaving the mouth of the bag projecting from under the book. Then blow steadily into the bag, the book will rise as the bag swells.

EVOLUTION OF LANGUAGE.

BY ADA S. BALLIN.

XI.

THE Chinese language bears traces of its great antiquity in the strong evidences of phonetic decay shown by the fact of the variety of meanings rendered by one sound. There are over 40,000 distinct words, or more properly speaking, characters, in Chinese, though barely 10,000 are generally used in the various branches of literature, and not more than 3,000, perhaps, in ordinary conversation. But to pronounce these 40,000 characters there are something *under* 500 sounds, putting the tones aside; and while there are a few sounds whose distribution, so to speak, among the characters is comparatively limited, there are others which are so widely diffused as to fill us with astonishment. For example, as Mr. Fred. H. Balfour writes to me, "I once had the curiosity to search through K'ang Hsi's Dictionary for all the characters pronounced like the fifth letter of our English alphabet. I counted considerably over seven hundred, and my teacher, a Pekingese, informed me that by going further afield, the list might be made up to a thousand." *Tseu* has sixty; *le*, eighty; *chin*, a hundred; *ke*, one hundred and eighty; and *e* no less than two hundred and sixty-five different symbols attached to the one sound, and there are not only hundreds of totally distinct characters with only one monosyllabic sound among them, but one of those characters often has a large variety of totally distinct meanings. I subjoin a few examples, culled from Williams's Syllabic Dictionary.

亂 *Lwan.* To bring into good order; a state of order; to confuse, to throw into disorder; to mislay; discord, confusion; insurrection, anarchy; out of place, disarranged; tumultuous; ravelled; to ferry over; the end of a song.

簿 *Poh.* Plants extended; trees appearing singly, no brushwood; grassy; thin; attenuated; subtle; a thin leaf or plate; a pellicle; poor, unfortunate; economical; light, few; to diminish; to slight, to treat coldly; suspicious of; to approach; an initial particle, ah, so; to reach or extend over; careless, inattentive to, anyhow; trifling; a curtain or screen.

子 *Tzŭ.* Anciently a child, but now confined to a son; a boy, a lad; a person; the people, in distinction from the prince; a sage, a teacher, a venerable and worthy man,

especially Confucius; to act in a filial manner as a son; to treat as a son; an heir, issue, posterity; a seed, a kernel; a term of respect, you, sir; or more familiarly a comrade; an officer; a viscount; the first of the Twelve Stems, relating to water and denoted by the rat; applied to the eleventh moon, and to the third watch from 11 P.M. to 1 A.M.; north, on the compass card; a spot; subordinate; &c., &c., &c.

當 *Tang.* What is suitable, opportune, convenient, or just; adequate to, competent; to bear, to take the responsibility; to act as, to be; equal to, to match; to make; to stand in contrast; to meet or occur; at the time of, when—in which sense it is often a form of the present participle; used as a particle, as, then, or throwing the sentence into the future tense; to decide, to manage, to mete out; to withstand, to bear against; to screen; to pawn or pledge; to consider as, reputed or looked upon as; to serve an end; instead of, as, for; to suit with; suitable, favourable; to deceive, to swindle; basis, foundation.

敬 when read *Kih*, means to respect; to beat; when read *Yoh*, it means a bright, pleasing sight, as a fine landscape.

One would naturally think that this strange phenomenon would cause great difficulties in conversation; but these are partially obviated by the introduction of the system of tones, of which there are four in the Peking Mandarin dialect, and five in the Nanking Mandarin dialect; partially by the context in which such words are placed, and partially by the fact that although Chinese is monosyllabic, a large proportion of the parts of speech are formed of two characters joined, or in apposition, of which each supplements and explains the other, the sound presenting a distinct dissyllable. As Sir Thomas Wade says: "Just as in English, if it be necessary to particularise whether by a certain sound we mean wright, write, right, or rite, we make our meaning clear by a context which shows whether the syllable uttered is that in shipwright, to write letters, right and left, or rite of baptism, so a Chinese will explain that the *ai* he is speaking of is the *ai* in *ai-ch'iu*, to implore, in *ch'ên-ai*, dust, in *kao-ai*, tall and short, or in *ai-hsi*, to love; but homophony being, in his language, as much the rule as in ours it is the exception, he is very constantly obliged to fall back on this expedient." In writing this difficulty of course does not occur, the context being clear.

The Chinese affirm that in high antiquity they used knotted cords instead of letters to constitute the signs of ideas, and convey the commands of their rulers. This means of communication was afterwards succeeded by symbols, from which the present system of writing was derived. Chinese historians attribute the invention of this system to Tsang-hëe, who lived in the reign of Hwang-te, more than two thousand years before the Christian era, who from observing a constellation in the heavens, the marks on the shell of a tortoise, and the print of a horse's hoof on the ground, conceived the idea of such a method of communication through the eye, in fact a system of ideography.

The idea that the development of the present system was artificial, as suggested in the above legend, cannot be seriously entertained, it was doubtless gradually and naturally evolved from the primitive picture-writing under the law of conservation of energy, by which a single line in time comes to do service for a whole figure. Modern researches endorse the opinion of Paù-shí, a Chinese scholar who lived about 1100 B.C., and who stated in his work that the greater part of the Chinese characters were originally hieroglyphic; but gradually changed for the sake of appearance and convenience.

The ultimate scheme is reducible to a few simple principles:—1. *Resemblance* of the figure to the object signified; as a circle for sun, a crescent for moon and the like. 2. *Reference to some property or circumstance.* 3. *Combination of thoughts* as *truth*, a combination of the signs for *man* and *word*. 4. *Contraries* are expressed by reversing or inverting the character, and so on.

A symbol representing two men with their backs towards each other, pronounced *pih*, signifies perverse, to turn away from, retreat, and in the modern language "the north," *i.e.* the back of the world. A combination of the words for "human hair" and "changing" means *old*. A certain character is doubled to mean "to follow," and tripled to represent "many."

The whole of the Chinese language is arranged in the dictionaries under 214 roots, or radical and original characters, which enter into the composition and influence the meaning of every word in the language, which are arranged as follows by Sir J. F. Davis.*

	Classes.		Classes.
Human kind and its relations	14	Objects in early art	41
Mammalia	8	Numbers	5
Other animals	7	Actions (verbs)	37
Vegetables	13	Qualities (adjectives)	30
Minerals	5	Undefined	1
Parts of animals	28		214
Other objects in nature	25		

Analysing a dictionary containing about 11,600 words, the above-named author compiled a series of most interesting tables, showing the total number of compound words into which each root enters, from which tables it may be seen that one word may give rise to some hundreds, for example, the word meaning "to walk swiftly" enters into 145 compounds, "to speak, express," into 373, "wheel, carriage," into 127, "garment" into 184, and so on, the seven most prolific roots comprehending between them no less than 3,385 words, classed as follows:—

	Compound.		Compound.
Man	478	Tree, wood	493
Mouth	437	Grass, herbs	470
Heart	467	And water	548
Hand	492		

The word "man" combined with "one" means *alone, deserted*; with "hundred" it signifies *centurion*, with "field," *husbandman*; with "village," *rustic*; with "emperor," *noble, elevated*; with "justice," *right, correct*, and so on. The character meaning *Sin*, "the heart," which is regarded among the Chinese as the seat of the affections, emotions and intellect, combined with *hea*, "downwards," means *downhearted*, with *taou*, "a knife," *grieved*; with *urh*, "the ear," it forms *che, conscience, a sense of shame*, &c. Under the radical *che*, "hog," is classed *seang*, "an elephant," under *new*, "an ox," *se*, "a rhinoceros," under the root for "dog" come wolf, fox, ape, and lion. The roots thus serve as the generic heads of the words into the composition of which they enter.

The process of the development of abstract from concrete words, which may be compared to that of the conventional sign from the primitive picture, can be more clearly traced in Chinese than in any other language, although in all it can be shown to have gone on the same lines.

Thus, *âr*, infant, used also as "little"; in diminutives *siŭ*, a character composed of those meaning *heart* and *blood*, signifies "pity"; *yè* (roof, man, dark) "night"; the ancient character for *gān*, "peace," "tranquillity," represented a woman under a roof—sitting quiet at home. Doctrine is

* See "Chinese Miscellanies," pp. 78–82.

rule-reason, trade=buy, sell; joking=laugh, talk; dialogue=ask, answer; duty=own part; *fú*, "a father."

We also find a large number of abstract ideas expressed by the combination or apposition of more than two words. Thus our idea of *creation* is translated by "open-heaven, split-earth"; *conduct* is rendered by the words for "speak, act, move, rest," or "words, ways, deeds." "The five lakes and the four seas" is their equivalent for "the world." "Food+cups" equals "feast"; "look+wait" means to visit friends. The figure for *hon, hān*, "cold," is made up of a man under a roof among grass, and over ice.

I have dwelt at such considerable length on the structure of the Chinese language because of the strong light it throws on the processes of the evolution of language in general; for, although the outer features of human languages, as of human faces, may differ, their physiological structure is on the same general principles, and I may be permitted, while expressing the conviction that in Chinese, as in other languages, the majority of imitative, or so-called onomatopoetic words have become unrecognisable by the process of phonetic decay, to strengthen my position by the quotation of a few imitative words now in use, which I have taken somewhat at random, and without making any particular search for them. In my article on "Demonstrative and Pronominal Roots" I gave some instances of natural and imitative sounds in Chinese. Summers, in his "Handbook of the Chinese Language," says: "Besides the ordinary interjections of surprise, admiration, &c., there are in the Chinese colloquial style a great number of expressions in imitation of the various sounds heard in nature (onomatopœia), as the *falling of water, jingling of crockery, bursts of laughter*, &c."—such is *fān-fān jáng-jáng*, to express the noise of business in a market-place (p. 95). Among many others I may select as examples *kiaū-kiaū*, "the crowing of a cock"; *siaū-siaū*, "the noise of wind and rain." To which examples I may add the following: *tíng* signifies "nail"; *kúng*, "a bow"; *hò*, "fire"; *shwuí*, "water"; *kīn*, "metal"; *shí*, "an arrow," with a different character, "an omen from heaven"; *pí*, "the nose"; *ping* is ice; *p'uk, p'u*, to hit with the hand; *kom, kān*, to dare; *hāu, k'āu*, breath, obstructed effort—as of speech; *hu, hāu*, to cry out; *ch'ui*, to blow; *küt, chüeh*, to hiccough; *ki, chi*, choked; *mău*, the low of an ox. The sign meaning *fău*, a bird flying upwards and not coming down again, is also read *păt, pu*, not. *T'ău* or *p'ău* is to reject with scorn and spitting; *lăn, lin*, to flow; *ts'ău, hsiu*, to swim; *fo, hwo*, fire; *ch'i*, the teeth.

INK *VERSUS* WRITING FLUID.

THOUGH the old-fashioned gallic ink had its faults, it was altogether superior to the "fluid writing ink" now in such common use. I know of no ink ever invented more undesirable than this last. It has great fluidity, be it granted, and this is doubtless a desirable quality. It also illustrates admirably several chemical principles, but they are not such as we desire to see illustrated when writing.

For example, it corrodes the metallic pen we are using; but it is not pleasant when, perhaps after long searching, one has found a pen which writes with absolute smoothness and neatness, to have that pen presently spoiled, even though the process by which the metal of the pen enters into chemical combination with the acid of the ink be scientifically interesting. (I am myself, like most rapid writers, rather hard to please in the matter of pens.)

Again, the fluid ink writes light though the writing presently turns dark, owing to a chemical change of considerable interest; but every literary man likes his writing to be dark from the start. An even worse fault of the truly hateful compound called writing fluid is that if you pause to think (a process considered occasionally allowable even among literary men, but which the inventor of the fluid evidently failed to take into account), the chemical process by which your pen is being destroyed takes place so effectively as to transform the green fluid into a sickly yellow, which does not turn black after writing. You are obliged to take a fresh supply of the fluid on your nib, if you would not have several words of your writing of the colour which our Irish friends poetically term "dunducketty mud colour." (To be scientifically accurate you ought to dry the pen before taking this fresh supply.)

Yet again, the fluid ink is so undesirably fluid that manuscript written with it is bound to be plentifully smeared; for the ink is ready to smear long after any reasonable ink would be dry.

The fluid ink seems to have been invented solely in the interests of the makers of steel pens; for while, in the first place, it cannot be used with quill pens, since the chemical changes on which its ultimate blackness depends require the iron of the pen, it so rapidly destroys steel pens that one must use at least three times as many as one would require with good ink.

The old-fashioned ink could be used to produce the best dead black colour known to me. (The discovery is original with me, so far as I know.) You take black French chalk—the usual crayon chalk—and score over with it the surface you wish to blacken, paying no special attention to uniformity, and leaving all the chalk dust on the sheet. Then with a brushful of the old-fashioned gallic ink (or you may use a feather) you go over the surface thus roughly blackened, and forthwith find that a beautifully uniform black is produced, which on drying is a fit surface for drawing on with coloured or white chalk. It is especially desirable for pictures of nebulæ, comets, and other such objects.

It is essential when ink is used for written records, if such records are to be safe, that the ink should resist all such chemical processes as reverse the changes considered above, turning coloured into colourless matter. It is well known that the old-fashioned ink yields to several chemical agents. If advantage were only taken of this to remove ink-stains where ink-stains are not desirable, this would be a gain rather than a defect. But records of various kinds may be treated with chemicals till the ink disappears, with results altogether undesirable. A solution of oxalic acid, or of hydrochloric acid, will act as an effectual bleacher in the case of all ordinary inks, the acid of the solution entering into combination with the metallic colouring material of the ink, leaving one colourless liquid and producing another. If the ink-marks thus removed be records relating to property, signatures to deeds, the filling-in of cheques or the like, the results of such chemical experiments are by no means such that the persons chiefly interested in them can regard them as pleasing. They will, however, continue to be performed until or unless the inks used for such purposes be absolutely indelible.

Now, it will probably have been noticed by many that the printed matter is not affected at all by the agents which remove ink-stains. The reason of course is that the ink used by printers owes its blackness to lampblack, which is almost pure carbon, carbon being of all elements the one which most stubbornly resists the attacks of the agents usually most effective in producing chemical change. We recognise here the true principles on which ink for written records should be prepared. The base should be carbon-

aceous, such other substances only being combined with the carbon as will give it a hold on the paper, without which of course the ink might be simply washed off. This hold on the paper should be such in some cases (as for cheapness, &c.) that the written matter cannot be removed by any mechanical means without destroying the paper itself. I find that among the Kosmian inks the requirements of indelibility and suitable hold on the paper to prevent mechanical removal are admirably provided for, and, from experiments I have made on this ink, I infer that it is essentially a carbon ink.

SIR WM. HERSCHEL'S SURVEYS OF THE HEAVENS.

DURING the interesting discussions respecting the temporary star in the Andromeda nebula, the misapprehensions which prevail in regard to the magnificent work of the Herschels, and especially of the elder Herschel, were very prominent. Darwin has been wildly and widely misunderstood; insomuch that most men imagine his theory (and Wallace's) merely another form of Lamarck's, that he believed in evolution towards perfection, that according to him each race has descended from a pair of its own kind, and that he regarded apes closely resembling some now existent anthropoids as the ancestors of the human race. And those who thus misunderstood Darwin are hard to convince: they will not believe, when science assures them that Darwin's theory was accepted by men who had utterly rejected Lamarck's, that he recognised evolution as often tending to deterioration rather than to improvement, that the descent of any race from a pair is absurdly inconsistent with the doctrine of natural selection, and lastly, that, as regards the period when man and the present anthropoid apes diverged, the Darwinian theory would indicate ancestors at least as like man as like any existent ape, and probably much more like—for the simple reason that man has descended directly from that ancestry, while the existent anthropoids have shared descent from it with descent from contemporaries of lower race. But, preposterous as have been the mistakes made about Darwin's doctrines, they can hardly be compared with those into which even many men of science and astronomers have fallen respecting the labours of Sir William Herschel. He was an observer of the heavens for more than forty years, during all which time his active mind was busily engaged applying various methods of inquiry, inventing new ones, and testing old ones; yet many seem to imagine that at the end of his long series of labours he stood in the precise position which he had occupied at the beginning. They quote an opinion expressed during the last ten years of his work, and an idea suggested thirty years before, in one and the same chapter, nay, in the same paragraph, and even in the same sentence. Or, which is not less incorrect, though not so obviously absurd, they point to a result which he had obtained from one series of observations and had interpreted on one particular principle, as establishing such and such a conclusion when interpreted on another assumption—this assumption having been adopted indeed by Herschel at one part of his labours, but long given up when he had adopted the principle by which he had explained that result.

It is not commonly known, even though on this point the whole value of Herschel's labours in reality depends, that he employed two entirely different methods for gauging the star depths. One would imagine that they must have been so similar as to be easily confounded together, seeing that (except the present writer) only one student of astronomy, the late W. Struve, has ever insisted on the distinction between them. Even W. Struve, in his justly celebrated (but little read) "Études d'Astronomie Stellaire," failed to notice how inadequately Herschel had been able to test the second method, his career as an observer having come to a close less than four years after he had devised it. In reality, however, these methods, which Arago, Humboldt, and other men of note, as well as hundreds of the mere astronomical compilers, have confounded together, presented the following points of rather strong contrast:—

Herschel's first gauging method depended on turning one powerful telescope to different parts of the stellar heavens in succession; his second method depended on turning many telescopes (ranging in power from his smallest to his largest) successively to one and the same star-groupings. The first depended on the assumed power of penetrating in all directions to the outermost limits of the galaxy; the other depended on the observed fact that in many directions the galaxy is unfathomable. In applying the first method Herschel counted the number of stars in each field of view, and judged the depth of the system to be proportional to the number so counted; in applying the other he did not count the stars at all, but noticed only how much of each field was cleared by the space-delving power of each of the telescopes successively employed. (One may say that in one method he counted stars, in the other he counted telescopes.) The former method depended on the assumption that the wealth of stars in the Milky Way resulted from the enormous length of the range of view through regions occupied by stars uniformly strewn; the second had been devised because, in his own words, he had "found after a long inspection and examination that the stars in the Milky Way are arranged very differently from those in our neighbourhood." Lastly, the first method was subjected to more than thirty years' testing before its fundamental assumption was thus recognised as erroneous; the second method was tried only for about three years, and the results accumulated during that time were never employed to test the validity of the primary assumption, but presented only as indicating such and such conclusions *if* the initial assumption were trustworthy.

That two methods so utterly unlike, nay, so opposite, in plan, purpose, and principle, requiring such different methods of observation, and so different in their history, should have been confounded together, would be amazing were it not that men are so much readier to accept plain statements as to facts than to analyse either preliminary explanations or subsequent reflections. If Herschel, interpreting his earlier gauges by his first assumption, said that the galaxy extends ten times farther towards the Milky Way than towards the regions with black background—there is a simple fact to be quoted; let it be entered in our note-book. If he found, interpreting his later gauges on his second assumption, that the Milky Way is in many places unfathomable—*that* is not only a simple but an impressive statement; by all means put that down too. It may not seem consistent with the former; but both statements were made by Herschel; both appear (with only a trifling interval of thirty years or so between them) in the "Proceedings of the Royal Society": there can be no objection to their being used in the same paragraph, or even the same sentence. Herschel could not analyse the outermost parts of our galaxy, therefore they are hundreds of years' light-journey away; it would be a pity to omit *that*. And he considered the nebula in Andromeda very near (on the principle of his second gauging method), because his smallest telescope, nay, even the naked eye, shows its milky

light—*that* also must be mentioned. The nebulæ he could resolve into stars Herschel regarded as near; the Andromeda nebula, which he could not so resolve, he considered, so judged, to be much farther away. This result, being inconsistent with the other, might be supposed to suggest doubt whether we must not give up either the principle of inferring distance from the telescopic power required to show an object, or else the principle which depends on the power necessary to resolve an object into stars; for the Andromeda nebula cannot be at once the nearest of the nebulæ, as Herschel inferred when using one principle, and one of the farthest, as another principle which he had suggested would obviously teach. This, however, has by no means happened. Both principles are blandly quoted, not only in text-books of astronomy, but by astronomers who do not write text-books. Except by the present writer, and earlier (but independently) by Mr. Herbert Spencer, the obvious—one might almost say the staring—discrepancies between the results given by the two methods of star-gauging have not been noticed. Sir John Herschel, however, noticed even earlier the simply decisive evidence given by the Magellanic Clouds, and pointed out that this evidence threw doubt on the results commonly quoted as established by his father. Doubts, indeed! Clouds, looking like rounded masses of milky light, contain stars of all orders, from the seventh magnitude, down to the faintest which even a two-feet mirror will show, and patches of absolutely unfathomable nebulosity, besides all classes of nebulæ; so that these clouds, interpreted by the two methods of star-gauging, consist of series of marvellously attenuated spike-shaped regions of stars—the spikes all, by a strange chance, pointing directly from the solar system, while also these spikes, really belonging to our own sidereal system, all point directly towards remote galaxies lying at distances exceeding thousands of times the whole span of our galaxy. This is not merely incredible, it is impossible; for such spike-shaped arrays of stars could not remain in that preposterous form, even if they could assume it for a single day.

It has been only through the careless commingling of Sir W. Herschel's varied results and methods that absurdities such as these have been associated with his splendid labours, and it has only been by entirely misinterpreting the immense mass of material he has collected, and applying remarks made at one time to results noted at another when his views had entirely altered, that the idea of objects thousands of years of light-journey from our system has come to be regarded as anything beyond a mere speculation. It only appears in Herschel's papers in company with an assumption which has long since been entirely disproved.

Gossip.

By RICHARD A. PROCTOR.

THERE is no room this month for the Chart of Mars, which is now, however, in the engraver's hands, and will appear next month.

* * *

THE series of papers on Spectroscopic Analysis promised for the present volume has been delayed chiefly by want of space. We have had to find room for several matters which had not been taken into account or looked for. I may note here that papers on spectroscopic analysis, considered as it has to be considered in text-books, would have no value here. Only such matters will be considered as are usually left untouched in such books. In particular, the laws on which the formation of the diffraction spectrum depend will be carefully dealt with. This matter has been either wholly neglected in the text-books, or such explanations have been given as scarcely any fellow not a fellow of a mathematical society could be expected to understand or follow.

* * *

A CORRESPONDENT invites me to write a series of articles with illustrations showing how the constellations appear to the inhabitants of planets attending on other suns than ours. I can very readily state and illustrate all I know, or could by life-long labour learn, on this portentous subject. Omitting three stars, all I know about it is indicated between the end of this paragraph and the beginning of the next.

* * *

IN KNOWLEDGE for May last there occurs, in one of the short reviews, an expression relating to the last Government for which I deem it just to offer apology. The author of the review must not be understood therefore as necessarily considering that any apology is necessary on his behalf. It is solely for myself, as conductor of KNOWLEDGE, that I speak. I offer no opinion about the late Government or about the particular matter on account of which an expression belonging too clearly to the vocabulary of abuse (so Bob Acres thought, anyway) is applied to that Government. I only note that KNOWLEDGE must not deal with politics, save as they bear on sociology, which is a department of science. It has always seemed to me unfortunate (sociologically speaking) when newspapers (even partisan organs) substitute personal attack for the discussion of the principles on which the conduct of political matters should depend. I reside in a country where the great body of the people seem to expect their newspaper writers to be virulent; but the better sort, even here, do not like to see personal attacks in the daily journals. I should be sorry to see our newspaper writers in the old country "letting their angry passions rise" and their tone sink, as happened I fear (I hear so) during a recent struggle into which somehow Donnybrook Fair fashions (perhaps naturally) found their way for awhile both in Parliament and in the papers.

Reviews.

Practical Education. By CHARLES G. LELAND. (Whittaker & Co.)—We owe a good many bad things to commercial competition, and some good things; and among these last, perhaps, may be classed the demand of late years for practical education. Granted that a boy must have his mind sharpened upon some whetstone, is a Latin whetstone the only one that will suit? Allowing that there are certain things which must be learnt while a boy is at school (as, for example, the elements of literature), may no seeds be planted to develop later that may bear actually on his future work, and fit him earlier for the battle of life? Our English education has been one-sided far too long. *Aut Cæsar aut nullus* may be freely translated for our public schoolboys—"either a classic or a duffer;" and our modern sides have generally been the intellectual dustholes of the schools. "Rubbish may be shot here" would be a suitable motto for the doorways to the classrooms, and all who enter abandon hope of success in their school life. But the times are changing, and Mr. Leland's book is a valuable contribution to the discussion of an important question. Mr. Leland may say *crede experto*, for his plans have been tested and found successful. As a supplementary course to their ordinary school-work, his pupils pursue many light, interesting, and useful arts—as carpentering, leather-work, carving, *repoussé* work, and so forth. These have as their

basis a training in design, and even if Mr. Leland's pupils never get beyond admiring artistic effects, and striving to imitate and originate them, it would be a great thing. But he claims that they have been eminently successful; and while we do not quite like the occasional reference (as if it proved the writer's case up to the hilt) to the fact that "such a pupil could easily earn two dollars a day," his plans are, we think, very good. The Sloyd or Slöjd system of manual instruction to which Mr. Leland alludes in his preface, and of which, we think, he should have known earlier, hardly competes with his method. It might even be dovetailed in with it, as an elementary branch. In giving its pupils a model to follow strictly, and leaving no room for imagination or design, it is decidedly inferior to the plans pursued by our author. In the chapters on memory Mr. Leland has dealt with the decay of this power under the influence of printed books. But we think that here he unduly estimates the powers of the ancients; probably an educated man nowadays, knowing some one thing well, the elements of numerous subjects, and where to look for details, *remembers* a great deal more than the average educated man of centuries back. The marvellous stories told by Mr. Leland as to feats of memory we are bold enough to doubt. The book is, however, readable and well worth reading.

Electrical Instrument Making for Amateurs. By S. R. BOTTONE. (London: Whittaker & Co. 1888.)—We may fairly say that Mr. Bottone has produced the very model of what a practical handbook should be. On the value and advantage to the amateur of being able to construct his own apparatus it is needless here to insist, and the pupil who places himself in our author's hands must be incredibly idle and inattentive or abnormally stupid should he fail to produce satisfactory results after a study of the little book before us. The descriptive language is of the plainest, and an abundance of woodcuts suffices to make everything needing illustration clear and intelligible. Every student of electrical science should purchase Mr. Bottone's small work straightway.

The Pattern-maker's Handybook. By PAUL N. HASLUCK, A.I.M.E. (London: Crosby Lockwood & Son. 1887.)—Castings in iron, brass, and other fusible metals are made, as many who will read these lines know, from wooden patterns which are imbedded in what is called moulding sand, on their withdrawal from which hollow moulds are left into which the molten metal is poured. Very great art and nicety indeed are involved in the construction of these patterns, as, to take a single illustration, if the lower part of the model were in the least degree larger than the upper portion, it never could be extracted from the sand at all without breaking such sand down. Mr. Hasluck's book, then, goes into the details of construction at once of the simplest as of the most complicated patterns likely to be met with in practice. It forms a most valuable, if not indispensable adjunct to Mr. Graham's "Brassfounder's Manual."

The Gospel in Nature. By HENRY C. MCCOOK, D.D. (London: Hodder & Stoughton. 1888.)—Eloquent in diction, and replete with a wealth of illustration, these sermons of Dr. McCook's seem admirably adapted to carry conviction to the minds of—those who believe already! For through the entire book runs the most obvious *petitio principii* that every word of the Bible, as we have it, is supernaturally free from error, and that the myths and legends of the earlier books in it are as irrefragable history as a report in "Hansard" is of a debate in the House of Commons. We need go no further than our author's illustration drawn (on p. 80) from the battle of Beth-horon, although we are thankful to say that he stops short at the hail and thunderstorm, and does not inflict the story of the sun and moon standing still on his readers. How much of their history (so called) the Jews derived from the Chaldæans we are only just beginning to apprehend. But the point upon which we would particularly insist is that the very natural phenomena which he adduces in proof of the harmony between science and revelation might be quite as justifiably employed by the Parsee to show the divine origin of the Zend-Avesta, or by the Brahman to prove that the Vedas were inspired. It seems like killing the slain to point out that (on p. 113) he refurbishes Paley's exploded argument, that any one seeing a clock (it was a watch in Paley) must perforce be convinced that that clock had a designer; ignoring the fact that such supposition would only occur to a person who had previously seen a piece of mechanism of some sort in the course of construction. Did Dr. McCook never hear of the Highland soldier, who, having robbed the body of a dead officer of his watch at Prestonpans, and being absolutely ignorant that it required winding up, gleefully sold it next day for eighteenpence, as (he subsequently told his comrade) "she had died in the night"? Millions of men have seen various pieces of machinery made, or are familiar with those who make them; but we have, so far, never yet met with a man who has witnessed the construction of an echinus or a giraffe. Be it remarked that we are neither denying nor asserting that marks of design are visible in nature; we are only predicating the utter failure of Dr. McCook's illustration to prove it. People, though, who care for sermons, and who require something above the level of ordinary pulpit platitudes, may do worse than obtain the volume before us.

The Religious Sentiments of the Human Mind. By DANIEL GREENLEAF THOMPSON. (London: Longmans, Green, & Co. 1888.)—So comparatively large a proportion of mankind take their religion from their priest or minister, as they do their physic from their doctor, that to speak of a science of religion must appear to them as something akin to blasphemy. Their mental attitude is scarcely caricatured in the more or less veracious narrative of the small child in the Sunday-school, who, when asked what faith was, replied, "Believing what you know isn't true!" And yet a little dispassionate reflection must suffice to convince any impartial thinker that the religious sentiment, like any other mental affection or operation, must have its origin in the constitution of the human mind, and must be as amenable to investigation as any other psychical condition, whether perceptive, intellectual, volitional, or emotional. In the very able and thoughtful work before us, then, Mr. Thompson traces the genesis of the idea of the supernatural, and exhibits, in more or less detail, the forms in which it has subsequently been developed: the ultimate conclusion at which he arrives being that while we really *know*, and can know, nothing of the matter in any legitimate sense, yet that the balance of probability inclines towards the existence of the supernatural, and of, in some form, a future life. He then discusses our religious sentiments in relation to feeling and conduct; incidentally treating of the various conditions of existence in another world which have been imagined by divers schools of thinkers. In the concluding portion of his remarkable volume he deals with the application of the principles he has enunciated to popular education, and here makes a suggestion which will assuredly set by the ears the thousand and one sects who figure in every census. It is neither more nor less than this, that no dogmatic theology should form any part whatever of the curriculum of public education, but that if religion is to enter at all into such curriculum, the students should be carefully instructed in the arguments against as well as those for each and every

form of religious belief—leaving him or her to decide between them. That, in the existing condition of the theological world, this idea must remain a purely Utopian one, no one familiar with the intense sectarian bitterness prevailing there can for an instant doubt. The eagerness with which the clergy of one persuasion expose the artifices of those of another was the subject of comment by Buckle long ago, but to suppose, for example, that an upholder of the Athanasian Creed will consent to the presentation of that remarkable confession of faith side by side with the Unitarian (to say nothing of the scientific) arguments against it, is to imagine that human nature will change *per saltum*, or like a conjuring trick. The present intellectual attitude of every professor of the myriad forms of "faith" with which the world is afflicted, from the Churchman down to the Shaker, is embodied in words used to the writer by one of the most ignorant young men among all his acquaintance, "Other people only believe that they are right, but I know that I am;" and as long as this deplorable mental attitude persists, any advance in the direction so ably advocated by our author is hopeless.

A Treatise on Electricity and Magnetism. By E. MASCART and J. JOUBERT. Translated by E. ATKINSON, Ph.D., F.C.S. Vol. II. (London: Thos. De la Rue & Co. 1888.)—This second volume of the great work of MM. Mascart and Joubert is devoted to the methods of electrical measurement, and to the applications of electricity and magnetism. It treats the whole subject exhaustively, both mathematically and experimentally, and is a book without which the library of the advanced electrician is distinctly incomplete.

The Long White Mountain: a Journey in Manchuria. By H. E. M. JAMES. (London: Longmans, Green, & Co. 1888.)—The geographer, the ethnologist, the historian, the theologian, and the politician, alike with him who reads merely for amusement, will find a fund of matter for thought in Mr. James's interesting, important, and very readable volume. In these days, when books of travel are compiled by so many who simply take a return ticket to the United States by a Cunard steamer, or who go a little off the beaten track in the Tyrol, it is positively refreshing to sit down to the perusal of a narrative of the exploration of a country practically wholly unknown to Europeans, related in the manly and straightforward way in which Mr. James tells his story. A Bombay civilian, he became entitled in the winter of 1885 to two years' furlough, and in company with Lieutenant Younghusband, of the King's Dragoon Guards, he determined to devote a portion of his leave to a journey through Manchuria. A glance at a map of Asia will show that this forms the north-eastern portion of the Chinese Empire, being conterminous with the Russian dominions on the north and east, and with the Corea on the south. Its area is approximately 180,000 square miles, and our author estimates its population as between 20,000,000 and 23,000,000. The reigning Chinese dynasty had its origin in one of the three provinces (Fêng-t'ien) into which Manchuria is divided. So utterly ignorant have Europeans hitherto been of Manchurian geography that, in a map issued not long since by the Royal Geographical Society, a chain of snow-covered mountains some 12,000 feet high appears which has no objective existence whatever! In the southern and eastern part of this strange country, though, "The Long White Mountains"—which give their name to the work before us—are actually to be found, and very grand must be the landscapes in which they form a prominent feature. A facsimile of a coloured sketch by Mr. Younghusband of the so-called "Dragon's Pool" at the very summit of the range forms an appropriate frontispiece to the volume. At a place called Yingtzu, on their way from Newchwang to Moukden, our travellers were joined by Mr. Fulford, of the Consular Service, who as a good linguist and first-class shot formed a valuable addition to the party. We do not propose to follow them here through their long journey of something like 3,114 miles in unknown regions, a journey often performed under circumstances of difficulty and peril well calculated to have deterred men of merely average resolution and pluck altogether. The reader will thank us for sending him to gather the details from Mr. James's book itself. We need merely say here that its perusal will throw fresh and valuable light upon the condition of the Chinese empire, and on the nature of its relations with Great Britain. Some additional insight into Russian policy in Asia may also be obtained from its pages. A good idea, too, will be gathered of the kind and amount of success attained by the various missionaries—Catholic and Protestant—who are making so heroic a fight for their own forms of faith in these remote regions. Finally, we earnestly recommend every impartial inquirer to study carefully our author's utterances on the opium question, concerning which as much utter cant has appeared in this country as has ever been written or spoken even about total abstinence or vegetarianism itself. An excellent may and an exhaustive index add materially to the value of Mr. James's volume, which we have no hesitation in pronouncing *the* book of travels of the season.

The Naturalist in Nicaragua. By THOMAS BELT, F.G.S. Second edition, revised and corrected. (London: Edward Bumpus.)—We heartily welcome this reprint of one of the most fascinating and instructive narratives of travel ever published, for the first edition is not only out of print, but very scarce. Apart from the vivid descriptions of Central American scenery which brighten its pages, it evidences throughout to the powers of minute observation, and of insight into the deep significance of the actions of the humbler life-forms, especially of ants, which its lamented author possessed, and which won for his work Darwin's unstinted praise. That "hall-mark" should suffice as inducement to our readers to buy the book. The excellent woodcuts, which were a feature of the first edition, have lost none of their freshness.

The Demon of Dyspepsia. By ADOLPHUS E. BRIDGER, B.A., M.D., &c. (London: Swan Sonnenschein, Lowrey, & Co. 1888.)—Under this somewhat affected title, Dr. Bridger has produced a work of sterling value and use, and one which may be read with pleasure and profit alike by the dyspeptic and by the happy man possessing the ostrich-like power of "digesting a tenpenny nail." Our author enters very fully indeed into the nature of perfect digestion, the value of various kinds of food, and the results, primary, secondary, and tertiary, of deranged digestive powers. To read his chapters on "Vegetarianism" and "Stimulants and Stimulation" after the perusal of the rant of the Allinsons and Wilfrid Lawsons is akin to turning from an essay by a flat-earth man like Mr. John Hampden to Sir John Herschel's "Outlines of Astronomy."

The Farmer's Friends and Foes. By THEODORE WOOD, F.E.S. (London: Swan Sonnenschein, Lowrey, & Co. 1888)—Mr. Wood will be remembered as the author of that well-written and interesting little book "Our Insect Allies," and we may say in the outset that the qualities which rendered that work at once so valuable and readable are possessed in a high degree by the volume before us. It is one which should be in the possession of every agriculturist: farmers, as a rule, having but indistinct ideas as to what forms of animal life it will best pay them to preserve. The two solitary birds whose presence on a farm Mr. Wood regards as an unmixed evil are the wood-pigeon and the bullfinch, while he has a good word—in point of fact a great

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many good words—for that pariah among the feathered tribes, the sparrow. Many will learn with some astonishment how much they are indebted to the frog, the toad, the lady-bird, and the glow-worm, among other unsuspected benefactors. Even apart from its mere economic value, the work whose title heads this notice will furnish a fund of interest and amusement to every dweller in the country by its descriptions, at once accurate and picturesque, of the myriad forms of life which either benefit or injure us. It is worthy of note, by the way, that some of the farmer's friends are bitter foes to the horticulturist; but Mr. Wood always candidly warns us when this is the case.

Messrs. Cassell & Co. send us copies of their admirable *New Standard Drawing Copies*, prepared to meet the latest requirements of the Science and Art Department; and of the "Sixtieth Thousand" of the *Citizen Reader*, describing in clear and attractive style the machinery and institutions of the State. *Hazell's Annual Cyclopædia* improves by experience, and there are few holes to be picked in this year's issue. It has become an indispensable companion to Whitaker.

Messrs. Griffith & Farran send us a compendious *Every Day Dictionary*, and the second and cheaper edition of M. CHAPLIN-AYRTON'S *Child-Life in Japan and Japanese Child-Stories*, a delightful book, quaintly illustrated by native artists. Messrs. Hamilton, Adams, & Co. have issued an abridged edition of the ever-readable but now little-read *Noctes Ambrosianæ*, with which we advise a generation that knew not "Christopher North" to make acquaintance. Among serials we have the *Century*, with Matthew Arnold's posthumous paper on Milton; *Longman's Magazine*, with a moderate and useful paper by Dr. Richardson in favour of vegetable diet; and the *Westminster Review*, which improves every month—the May number is far and away the best among the half-crown magazines. Among the articles of sterling value are those on tramps of the past and present; England, or rather London, in the last century, as seen through French and German eyes; and a painful but valuable paper, quite remarkable of its kind, on the cure of habitual drunkards, by one who thus signs himself, and who tells the story of his shame and ultimate rescue. Space does not permit us to do more than make bare reference to an article in the *Edinburgh Review* for April on "Darwin's Life and Letters," in which the reviewer glories in his shame that he has always opposed the theory of natural selection.

Our Whist Column.

BY "FIVE OF CLUBS."

THE following game, played in Sydney on March 10, 1888, was contributed by Y to the *Australasian*, whose whist editor has kindly sent it to us. We give his notes first; and some comments of our own afterwards. (Z was a visitor from England, the rest were Sydney whist-players.

THE HANDS.

B { S. (*trumps*).—Kn. H.—10, 6, 5. / D.—Q, Kn, 6, 4. C.—9, 8, 7, 4, 2. }

Y { S (*tps*).—9, 8, 7, 3, 2. D.—Kn, 8, 5. H.—K, 9, 4. C.—Kn, 6. }

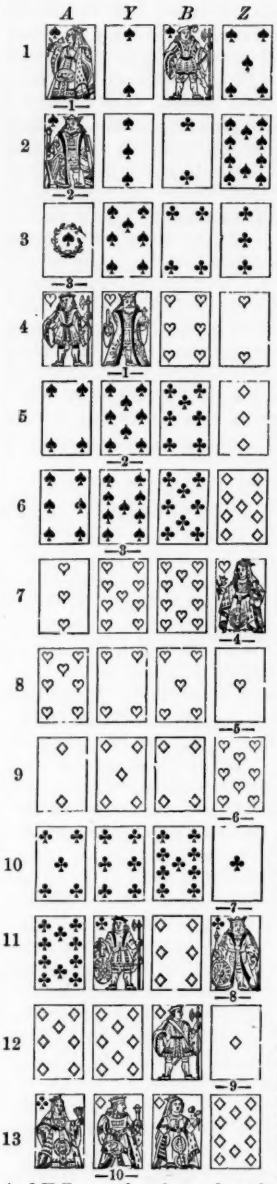
B / Y Z / *Tr.* S. 10 / A leads.

Z { S. (*tps*).—10, 5. D.—A, 10, 9, 3. H.—A, Q, 8; 2. C.—A, K, 3. }

A { S. (*trumps*).—A, K, Q, 6, 4. H.—Kn, 7, 3. / D.—7, 2. C.—Q, 10, 5. }

Score:—A B 1; Y Z 1.

Card underlined wins trick; card underneath leads next.



And Y-Z score four by cards and a double against four by honours.

NOTES.

Trick 1.—A leads correctly. With the exception of the Club Queen he holds no card outside trump which he is likely to make. He must, therefore, trust to finding his partner with some strength in the plain suits.

Trick 2.—This trick gives A the information that there are three trumps remaining in Y's hand. B's discard ought to have been the Heart, in which he has no strength whatever, rather than the Club, which, with the help of his partner, he has some chance of bringing in.

Trick 3.—A's lead of the Spade Ace is very injudicious play. By parting with that card he practically incapacitates himself from taking any further share in the direction of the game. He ought, in our opinion, to have played the Diamond Seven, on the chance of making one of his small trumps on the Diamond suit.

Trick 4.—Of course Y makes a bid for this trick, in order to have the opportunity of drawing A's losing trumps.

Trick 10.—At this point of the hand Z has two chances of winning the game. These are that the Diamond King is with Y, in which case it is quite immaterial how Z leads; or else that the Diamond King is with A, and the Diamond Queen with Y. It is better, of course, to take advantage of a double chance than to adopt the line of play which cannot succeed unless one named card be in partner's hand. Consequently, Z ought to have led the Diamond Ten.

NOTES BY "FIVE OF CLUBS."

Trick 3.—Had not B mistakenly discarded a Club, indicating weakness in the suit, A might have led a small Club here, on the chance of making the Queen. Leading a Diamond there is rather more risk of Y's getting a lead and forcing out trumps. A single trick by A-B saves and makes the game—this is patent to the whole table; and it is absolutely essential to A-B to play as dark as possible. Heart Knave or Diamond Seven would at once indicate A's position. This applies to A's lead at trick 4, after his mistake in leading the Trump Ace.

Trick 8.—Z's play should be the Diamond Ten here, rather than at trick 10, though certainly at 10 if not made at 8 or 9. The reason for this lead is that given in the above notes.

M. LUDOVICI'S ART SCHOOL FOR LADY STUDENTS.—An interesting annual prize competition has been started in connection with this school, for the best subject picture. Three money prizes and three orders of merit in gold, silver, and bronze will be given. The awards will be made in October 1888, the judges being Messrs. Albert Moore, Mortimer Menpes, and G. H. Broughton, A.R.A. Messrs. Dowdeswell & Dowdeswell have kindly consented to lend their gallery in Bond Street for the public exhibition of the competitive paintings. As M. Ludovici has some very promising lady students, this competition is looked forward to with considerable interest.

THE FACE OF THE SKY FOR JULY.

BY F.R.A.S.

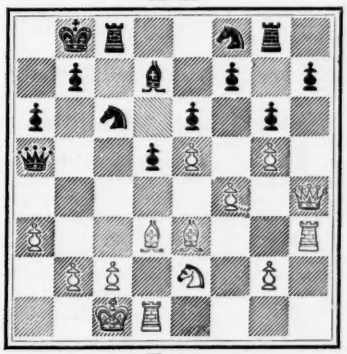
NO minute and rare are the spots on the sun's disc that they are not worth looking for. For the first three weeks there is no real night in any part of the British Islands. The face of the night sky will be found delineated on map vii. of "The Stars in their Seasons." Mercury is practically invisible at the beginning of the month, but becomes a morning star after the 9th, and on the 29th attains his greatest elongation west of the sun (19° 27′); at the end of July he may be seen before sunrise in the ENE. Venus is, to all intents and purposes, invisible. Mars is dwindling to a mere big red star. When viewed in a sufficiently powerful telescope it will be seen that his disc is gibbous and not circular; but very little of his superficial detail can be made out. He is a little to the north-west of Spica Virginis ("The Stars in their Seasons," map v.). Jupiter must be looked for as close to the meridian as possible, as he is very low down even at his transit. He is to the WNW. of λ Libræ ("The Stars in their Seasons," map vi.). The certainly visible phenomena of his satellites are very few. On the 1st, satellite ii. will be eclipsed at 10h. 57m. 27s. P.M. On the 2nd, satellite i. will enter on to the planet's disc at 9h. 30m. P.M.; followed by its shadow at 10h. 24m.; and will leave Jupiter's opposite limb at 11h. 43m. P.M. On the 3rd, satellite i. will reappear from eclipse at 9h. 52m. 25s. P.M. On the 6th, the egress of the shadow of satellite iii. will occur at 10h. 53m. P.M. On the 9th, satellite i. will begin its transit at 11h. 19m. P.M. On the 13th, the egress of satellite iii. will happen at 10h. 34m. P.M. On the 17th, satellite i. will be occulted at 10h. 25m.; and the egress of the shadow of satellite ii. take place at 11h. 5m. P.M. On the 18th, the egress of satellite i. at 9h. 49m. will be followed by that of its shadow at 10h. 56m. P.M. Lastly, on the 25th, satellite i. will begin its transit at 9h. 27m. P.M. Saturn and Neptune have both left us until almost the beginning of winter. Uranus may be picked up as soon as ever it is dark enough a little to the south of a line joining γ and θ Virginis ("The Stars in their Seasons," map v.). The moon enters her last quarter at 3h. 52·6m. in the early morning of the 1st, and is new at 6h. 6·7m. A.M. on the 9th. She enters her first quarter at 0h. 12·9m. P.M. on the 16th, is full at 5h. 45·1m. A.M. on the 23rd, and enters her last quarter for the second time this month at 8h. 29·6m. P.M. on the 30th. There will be a total eclipse of the moon in the early morning of the 23rd, but very little of it will be visible in this country, as the first contact with the earth's shadow occurs at 3h. 55m. A.M. and the moon sets at Greenwich at 4h. 10m. Seven occultations of fixed stars by the moon occur at more or less convenient hours for the observer during the present month. They are as follows:—On the 17th ξ^1 Libræ, a star of the 6th magnitude, will disappear at the moon's dark limb, at 7h. 22m. P.M., at an angle of 145° from her vertex, reappearing at 7h. 40m. at her bright limb at an angle of 176° from her vertex. On the 18th θ Libræ, a 4½ magnitude star, will disappear at the dark limb of the moon, at 9h. 2m. P.M., at an angle of 8° from her vertex. It will reappear at her bright limb, at 9h. 23m. P.M., at a vertical angle of 339°. On the 19th B.A.C. 5,700, of the 6½ magnitude, will disappear at the dark limb, at 10h. 26m. P.M., at an angle of 142° from the vertex of the moon, reappearing at her bright limb, at 11h. 14m. P.M., at an angle of 232° from her vertex. On the 21st o Sagitarii, a star of the 4th magnitude, will disappear at the dark limb of the moon 42 minutes after midnight, at an angle of 173° from her vertex; and reappear at her bright limb at 1h. 15m. the next morning at an angle from her vertex of 235°. On the 23rd, 20 Capricorni, a 6th magnitude star, will disappear at the bright limb at 9h.35m. P.M., at an angle of 64° from the vertex of the moon. It will reappear at her dark limb at 10h. 46m. P.M., at a vertical angle of 269°. On the 25th, 74 Aquarii, another 6th magnitude star, will disappear at the bright limb of the moon 57m. after midnight, at an angle of 80° from her vertex. It will not reappear at her dark limb until 2h. 11m. the next morning, at an angle of 308° from her vertex. Lastly, on the 31st, *f* Tauri, a star of the fourth magnitude, will disappear at the bright limb of the moon at 11h. 44m. P.M., at an angle from her vertex of 25°, and reappear at her dark limb 22m. after midnight, at a vertical angle of 297°. When these notes commence, the moon is in Cetus ("The Seasons Pictured," plate xxii.), out of which she passes at 7 o'clock in the evening into Pisces. She is travelling through Pisces until the same hour to-morrow evening, when she again plunges into the northernmost outlier of Cetus; and when she finally emerges from this at 4h. P.M. on the 3rd, it is to enter Aries ("The Seasons Pictured," plate xxiii.). By 2h. 30m. P.M. on the 4th, she has crossed Aries and entered Taurus. In the course of her journey over Taurus, she arrives at 1h. 30m. P.M. on the 7th at the western edge of the most northerly part of Orion. By 1h. A.M. on the 8th she has traversed this, and come out in Gemini ("The Seasons Pictured," plate xxiv.). She leaves Gemini for Cancer at 10h. P.M. on the 9th, and Cancer, in turn, for Leo at noon on the 11th. It takes her until 4h. A.M. on the 14th to traverse Leo, and she then enters Virgo ("The Seasons Pictured," plate xxv.). Her journey across Virgo finishes at 8h. A.M. on the 17th, when she passes into Libra ("The Seasons Pictured," plate xxvi.). Her path through Libra brings her at midnight on the 18th to the western edge of the narrow northern spike of Scorpio; and when, by 9 o'clock the next morning, she has crossed this it is to emerge in Ophiuchus. She passes out of Ophiuchus into Sagittarius at 9h. P.M. on the 20th, and from Sagittarius into Capricornus at 2h. 30m. A.M. on the 23rd ("The Seasons Pictured," plate xxi.). At 11h. 30m. P.M. on the 24th she leaves Capricornus for Aquarius. She remains in Aquarius until midnight on the 26th, and then quits it for Pisces ("The Seasons Pictured," plate xxii.). She passes from Pisces into Cetus at 7h. P.M. on the 27th, re-entering Pisces at 5h. A.M. on the 29th, only to pass again into Cetus at 2h. A.M. on the 30th. When she finally quits Cetus at 9 o'clock that night she enters Aries. She is in Aries until 10h. P.M. on the 31st, and then enters Taurus ("The Seasons Pictured," plate xxiii.). There we leave her.

Our Chess Column.

BY "MEPHISTO."

THE following position occurred in a game recently played between Zukertort and Gunsberg:—

GUNSBERG.
BLACK.



WHITE.
ZUKERTORT.

White played
22. Q to B2
which obtains a strong advantage in position; he threatens to win the Queen by B to Kt6. Q to R5 is no good, as White can attack the Queen by Kt to B3.

Black replied 22. Q to Qsq
which was not his best defence, as it increased the difficulties of the position by cramping his game still more. Kt to Qsq was better; if then 23. B to Kt6, Q to R5; 24. Kt to B3, Q to B3.

23. B to Kt6	23. Q to Ksq
24. B to QB5	24. Kt to K2
25. P to KKt4	25. K to Rsq
26. B to Q6	26. Q to Qsq

To prevent White playing Q to Kt6

27. Kt to Q4	27. B to R5

The sole idea of this move is to tempt White into advancing his Pawns on the Queen's side, thereby loosening his position and making a counter attack possible. The position, however, also required as a necessary accompaniment that Black should play R to Rsq. Not with a view to permanently defend the weak Rook's Pawn, but for the temporary purpose of enabling Black to bring his pieces into play, especially his Knight on Bsq, and to give up the KRP at a time when, by playing away the defending Rook, he should obtain some chance of a counter attack.

28. P to Kt3	28. B to Qsq
29. K to Kt2	29. B to Q2
30. P to B4	30. P × P
31. B × P	31. Q to Kt3

Black seizes a desperate chance to bring his pieces into play if

now 32. B × Kt, R × B seemed a compensating move, but it is not so, for White would then reply B to Q8, winning the exchange.

32. B × RP	32. Kt to Q4
33. B to Bsq	33. B to B3
34. Q to Q2	34. Kt to Q2
35. R × P	35. Kt to B4
36. B × Kt	36. Q × B
37. R to Bsq	37. Q to Kt3
38. R × P	38. R to Rsq
39. Kt × B	39. R × Kt

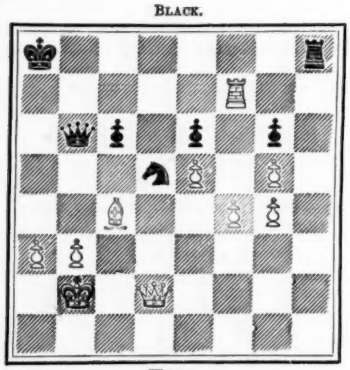
Black took with the Rook in order to exchange the White Rook, which acts as a protection to the King, in the hope of then being better able to menace White's position by means of the open Rook's file and the co-operation of Rook and Queen.

40. R × R	40. P × R

Black, of course, relies upon the Queen commanding the important diagonal leading to Q5 and KB7, for the possibility of a counter attack.

41. B to B4

BLACK.



WHITE.

Black, although he is 3 Pawns behind, has obtained what he was playing for, namely an open game.

Now in this position there are various points to be considered. Firstly, if Black plays his R to R6 or R8, White might probably advance his Pawns, Black could never play his Knight away, as White could then play R to B8 (ch), followed by Q to Q7 (ch). The Black Queen is also confined to the diagonal she occupies, on account of the check on R5. Nevertheless, there are four moves at Black's disposal. The move actually played was weak, namely—

	41. Kt to K6
42. B × P	42. Kt to B8
43. Q to Kt4	

and the position is hopeless as Black now has only one check, and he must exchange Queens.

Another move, which under circumstances might have been possible, but must now be dismissed as useless, is 41. R to R7. If now 42. Q × R, White will have no difficulty in avoiding the perpetual check consequent on Q to Q5 (ch). 43. K to B2, Q to B6 (ch). 44. K to Ktsq, Q to K8 (ch). 45. K to R2, Kt to B6 (ch). 46. K to Kt2, Kt to Q8 (ch). 47. K to B2, Kt to K6 (ch). 48. K to Q3, and White will escape the perpetual check.

A more likely move was

	41. R to Qsq
If now 42. B + Kt	42. R × B

If he does not take the Kt, White is threatened with many dangers, which promise to yield drawing chances;

43. Q to K2	43. Q to Q5 (ch)
44. K to R2	44. K to Ktsq
45. Q to Ksq	45. K to Bsq
46. Q to K2	46. K to Ktsq

and we fail to see that White can do anything but accept the draw, by playing

48. Q to Ksq

48. Q to R2 is useless, for Black simply answers Q to Q8, compelling White to play 49. Q to R8 (ch), R to Qsq. 50. R to B8, and Black draws by perpetual check.

Yet another move was

41. Q to Kt8

threatening to win the Queen; but then White could reply 42, B to Q2, as Black dare not move his Rook to R7 on account of Q to R5 (ch) and Q to Q8 mate. White could also venture on giving up his Queen by playing 42. B × KtR—R7, 43. B × P (ch) with a good prospect of winning.

THE HANDY CHART OF CHESS OPENINGS.*

Mr. Allan Greenwell, of the Newcastle Chess Club, has adopted an old idea, and made it serve a useful purpose. His "Handy Chart of Chess Openings" is, properly speaking, an index to all the Openings, and it is compiled in the manner of a tree, which makes it easy, after but a slight survey, to trace almost every move that is ordinarily played to the class of Opening to which it belongs. Of course if it is desired to follow up any particular variation, then a handbook on the Openings must be consulted. Nevertheless, although the chart, as before said, does nothing more than index the various Openings, it appears to us to be of invaluable service, as it brings within bird's-eye view the whole vastly complicated system of the Chess Openings, enabling every one to make himself familiar with the Openings, a knowledge which they might not otherwise acquire in a lifetime. We give a few specimens of this chart, which should be in possession of every chess-player.

W. 1.	P to K4	P to Q4	Kt to KB3	P to QB4
		Queen's Opening	Zukertort's	English Opening
B. 1.	P to K4	P to K3	P to Q4	P to QB4
		French Defence	Centre Counter	Sicilian
W. 2.	Kt to KB3	P to KB4	B to B4	QKt to B3
	King's Knight's Game	King's Gambit	Bishop's Game	Vienna Game
B. 2.	Kt to QB3	P × P	B to B4	P to Q4
		Accepted.		Declined.
W. 3.	B to B4	P to Q4	B to Kt 5	Kt to QB3
		Scotch	Ruy Lopez	Three Knights
B. 3.	B to B4	Kt to KB3	P to QR3	Kt to B3
	Giuoco Piano	Two Knights' Defence		

We would suggest that four more of these charts should be issued, namely, one for the King's Knight's Opening, one for the Bishop's Openings, one for the King's Gambits, and one for the Queen's Gambits. Thus completed, they would be extremely useful.

An untimely draw occurred the other day, which is worth recording, as it presents this curious fact, that a strong player was forced, very much against his will, to accept a draw after merely ten moves had been played. Theoretically this seems almost an impossibility, but practically such positions do occur. The game was played as follows:—

1. P to K4	1. P to K4
2. P to QB3	2. P to Q4
3. Kt to KB3	3. Kt to QB3
4. B to Kt5	4. Q to Q3
5. Q to R4	5. B to Q2
6. P × P	6. Q × P
7. Castles	7. B to Q3
8. P to Q4	8. P to K5
9. Kt to Kt5	9. P to KR3
10. B to B4	10. P × Kt

White now takes the Queen, and Black draws by perpetual check.

* Published by Franklin's, Newcastle-on-Tyne, price *6d.*

LAND ABOVE THE SEA LEVEL.—Mr. John Murray (of *Challenger* Expedition fame) has read a paper before the Royal Society on the height and volume of the dry land, and the depth and volume of the ocean. Only 2 per cent. of the entire ocean is included inside a depth of 500 fathoms, whilst 77 per cent. of the area lies between 500 and 3,000 fathoms, and the mean depth of the ocean is 12,480 feet. The mean height of the land above the sea level is 2,250 feet; so that if all the land were utilised to fill up hollows in the earth's surface the sea would cover it to a uniform depth of two miles.

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